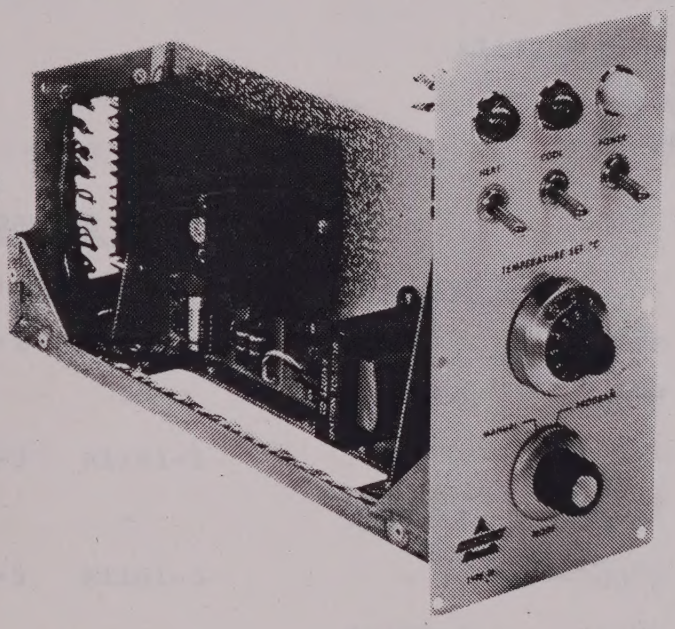
A 1160
A 1161
A 1172

INSTRUCTION MANUAL

Model A1160

A1161

A1172



DELTA DESIGN INC

TYPE III CONTROLLER

ENVIRONMENTAL CONTROL EQUIPMENT FOR RESEARCH AND INDUSTRY

5725 KEARNY VILLA ROAD • SAN DIEGO, CALIFORNIA 92123

Type III-~~11/82~~ 1080

Printed in U.S.A.

SPECIFICATIONS

DESCRIPTION OF MODEL NUMBER AND POWER REQUIREMENTS (Power derived from temperature chamber or handler)	A1160 - Type III, 120 VAC, 50/60 Hz, Single Phase.
	A1161 - Type III, 208/240 VAC, 50/60 Hz, Single Phase.
	A1172 - Type III, 208/240 VAC, 50/60 Hz, Single Phase - For use with Model 7650 Temperature Chamber.

TEMPERATURE RANGE

(120V)	(208/240V)	(208/240 for 7650)		(Front Panel)
A1160-1	A1161-1	-	-100°F to +600°F	Vertical
-	-	A1172-2	-100°F to +600°F	Horizontal
A1160-3	A1161-3	-	-73°C to +315°C	Vertical
-	-	A1172-4	-73°C to +315°C	Horizontal
A1160-5	A1161-5	-	-300°F to +600°F	Vertical
-	-	A1172-6	-300°F to +600°F	Horizontal
A1160-11	A1161-11	-	-184°C to +315°C	Vertical
-	-	A1172-12	-184°C to +315°C	Horizontal
A1160-17	A1161-17	-	-100°F to +350°F	Vertical
A1160-19	A1161-19	-	-73°C to +177°C	Vertical

RESETTABILITY	±0.14°C (±0.25°F)
CONTROL DEVIATION FROM SETPOINT	±0.06°C (±0.1°F)
LINE VOLTAGE STABILIZATION	±0.14°C (±0.25°F) for 105-125 VAC line voltage change.
	±0.14°C (±0.25°F) for 200-215 VAC line voltage change.
	±0.14°C (±0.25°F) for 220-240 VAC line voltage change.

NULL DETECTOR CONTACT CLOSURE	Air temperature (in chamber) will be within 2°C (3.6°F) of set temperature at 3 minutes after closure occurs.
NULL DETECTOR CONTACT RATING	.5 Amp or 10 Watts max. Contact protection provided by user to protect against inductive loads with P.F. less than .9.
PROGRAM CAPABILITIES	Remotely programmable by utilizing an equivalent resistive network.
CONTROLS	POWER ON-OFF Switch and light COOL ON-OFF Switch and light HEAT ON-OFF Switch and light TEMPERATURE SET Control MANUAL/PROGRAM Control Switch (MODE)
WEIGHT (approx.)	4 Lbs. (1.81 Kg)

NOTE: IT IS RECOMMENDED THAT THIS MANUAL BE READ THOROUGHLY BEFORE CONNECTING EQUIPMENT TO ELECTRICAL POWER SOURCE.

INTRODUCTION

The Delta Design, Inc. Type III Controller has been specifically designed for use with Delta Environmental Test Chambers and Handlers.

The Controller provides precision temperature control with time proportioned output to the chamber heaters and coolant valve. The temperature selected is maintained automatically by three modes of Controller operation: (1) application of heat, (2) application of coolant or (3) the absence of both.

A relay contact at the rear of the Controller closes when the temperature reaches the desired point. This contact closure can be used during automatic test programming and in conjunction with Delta's various programmers.

CONTENTS

	Page
SPECIFICATIONS	i
INTRODUCTION	iii
LIST OF ILLUSTRATIONS	v
1 PRINCIPLE OF OPERATION	1
1.1 Description	1
1.2 X-1 Option	1
2 INITIAL SETUP	2
2.1 Electrical Connection	2
3 STARTING UP PROCEDURE	3
3.1 Precautions	3
3.2 Controls	3
3.3 Setting the Dial Temperature Indicator	5
4 PROGRAMMING	4
4.1 Description	4
4.2 Null Detector Circuit	4
5 MAINTENANCE	7
5.1 Theory of Bridge Operation and Adjustments	7
5.2 Temperature Chamber Calibration Data	10
5.3 Calibration Procedure - Type III - General	11
5.4 Specific Calibration	13
5.5 Calibration Procedure - Controllers with X-1 Option	17
6 TROUBLE SHOOTING	18
6.1 General	18
6.2 Anticipator Wire Replacement	18
7 WARRANTY	19

LIST OF ILLUSTRATIONS

Figure No.		Page
1	Temperature Control System	20
2	Component Location	21
3	Four Arm Bridge	22
4	Bridge Components	22
5	Temperature Set vs System Temperature	23
6	Effect of OFFSET Adjustment on System Transfer Characteristics	24
7	Effect of SLOPE Adjustment on System Transfer Characteristics	25
8	Trouble Shooting: Electrical	26
9	Anticipator Wire Replacement	27

1 PRINCIPLE OF OPERATION

1.1 Description

1.1.1 With the Controller MODE switch in the MANUAL position, the Controller compares the resistance of a wirewound nickel probe element installed in the temperature chamber, to the resistance of a TEMPERATURE SET potentiometer. With the Controller MODE switch in the PROGRAM position, the probe resistive element is compared to a remote programming resistor supplied by the user.

1.1.2 The Controller will regulate the heat and coolant to maintain the set temperature, resulting in minimum coolant and power consumption.

1.1.3 A typical temperature control system is shown in block diagram form as Figure 1.

1.2 X-1 Option

1.2.1 Available as an option on the Type III Controller is the X-1 option. This provides the operator with a switch which permits selecting calibrated preset temperatures without changing the manual setting of the potentiometer. Turning the MODE control knob clockwise from the MANUAL poition past the PROGRAM position engages the preset temperatures. From one to ten preset temperatures are available.

2 INITIAL SETUP

WARNING

Ensure that all sources of power have been removed from the equipment prior to installing, removing or servicing the Controller.

2.1 Electrical Connection

2.1.1 Electrical Connection is made between the Controller and the chamber or handler at TB1 and TB2 on the rear of the Controller. For terminal designations see D1635617 for Model A1160, D1635618 for Model A1161 and C1643351 for Model A1172.

2.1.2 When the Controller and the chamber or handler are purchased as a unit, the Controller will be installed in the unit and calibrated prior to shipment.

3 STARTING UP PROCEDURE

3.1 Precautions

3.1.1 When the Controller is installed in a temperature chamber or handler and an external programmer is not being used, a safety plug (supplied with the chamber or handler) must be connected at the rear of the unit. This will preclude any accidental high temperature being obtained if the Controller MODE switch is placed in the PROGRAM position with an open PROGRAM input. The safety plug disables the heat and cool circuits of the Controller when the MODE switch is placed in the PROGRAM position.

3.2 Controls - Refer to Figure 2

3.2.1 POWER Switch and Indicator - On position - main power to the unit is on. White light is illuminated when power is on.

3.2.2 COOL Switch and Indicator - On position allows the Controller to apply coolant automatically to reach and maintain selected temperature in the test chamber. Green light is steadily illuminated when the chamber is cooling. Light blinks when the chamber reaches selected temperature below ambient.

3.2.3 HEAT Switch and Indicator - On position allows the Controller to apply heat automatically to reach and maintain selected temperature in the test chamber. Red light is steadily illuminated when the chamber is heating. Light blinks when the chamber reaches selected temperature above ambient.

3.2.4 TEMPERATURE SET Dial - Chamber operating temperature is set by dialing the TEMPERATURE SET dial to the desired degree (See paragraph 3.3 for setting information).

3.2.5 MODE Selector - The MODE selector provides MANUAL operation, remote PROGRAM operation and, if supplied with the X-1 option, selection of preset temperatures. (Reference paragraph 1.2 and 3.2.5.3).

3.2.5.1 MANUAL Position - TEMPERATURE SET dial determines chamber temperature.

3.2.5.2 PROGRAM Position - Programming resistance connected to the program jack at the rear of the chamber or handler selects chamber temperature when the MODE selector is in this position.

CAUTION

Ensure that the safety plug (located on the rear panel of the chamber or handler) is connected prior to setting the MODE selector to the PROGRAM position. This will preclude the possibility of high temperature being accidentally obtained.

3.2.5.3 X-1 Option - Turning the MODE switch clockwise from the MANUAL position past the PROGRAM position engages the preset temperatures. The first position past PROGRAM corresponds to the number 1 calibration position located on the P.C. Assy atop the Controller center section. Unless specified by the customer on the initial order, the set positions are not labelled. Engraving is available at the factory for any customer designation requirement.

From one to ten preset temperatures are available. For calibration see paragraph 5.5.

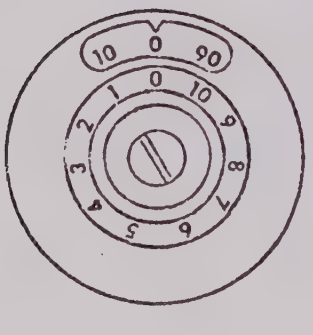
3.3 Setting the Temperature Dial Indicator - Type III Controller

3.3.1 Description - Refer to example A - Set both dials at zero.

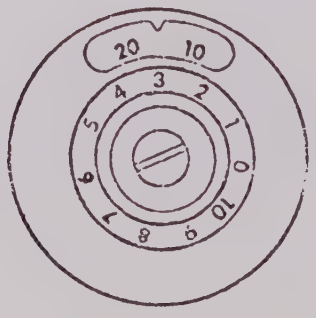
3.3.1.1 One complete rotation of the knob equals 100°. Clockwise is plus (+) degrees (F or C) and counterclockwise is minus (-) degrees. Each rotation of the knob is indicated by the small dial nearest the knob.

3.3.1.2 The large dial indicates each degree, every tenth numbered. Thus, as in example B, the large dial is set at 15, and the small dial is beyond 3, therefore the setting is +315°.

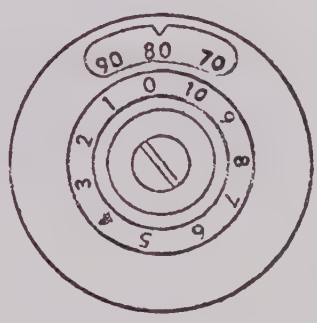
3.3.1.3 When setting to a minus (-) temperature, it is necessary to subtract the degrees from 100, i.e., 20 from 100 equals "80" reading on the large dial to have a setting of -20°. This is shown in example C. It will be noted that the zero on the small dial is just to the left of the marker. Also, on the models having a range greater than -100°, it is necessary to keep track of the counterclockwise rotation of the knob.



A
(0°)



B
(+315°)



C
(-20°)

4 PROGRAMMING

4.1 Description

4.1.1 With the Controller installed in a temperature chamber or handler, connect the correct resistances between pins 1 and 3 of the program jack. Set the MODE switch to PROGRAM and the HEAT, COOL and POWER switches to the ON position. The Controller will regulate heat, coolant or the lack of both to obtain and maintain the programmed temperature.

4.1.2 A safety plug is provided with the chamber or handler and should be kept connected to the PROGRAM input whenever a programmer or actual resistance is not connected. The safety plug disables the heat and cool circuits of the Controller and thus prevents the chamber from accidentally being programmed to a very high temperature.

4.2 Null Detector Circuit

4.2.1 A relay contact closure is provided at the rear of Type III Controller equipped chambers and handlers. This closure occurs when the chamber temperature reaches the indicated set point. It may be used to signal external equipment that the chamber has reached the selected temperature. Maximum rating of the contact is .5 amps or 10 watts, whichever is greater.

4.2.2 The Delta Design Model 9307, 9308 Hi-Lo Programmer, and the Model 9312, 9313 Hi-Lo-Ambient Programmers utilize the null contacts to start their timers when they are used with the various chambers and handlers. This contact closure feature is most useful in automatic test programming applications.

5 MAINTENANCE

5.1 Theory of Bridge Operation and Adjustments.

5.1.1 The Delta Type III Controller utilizes a basic four arm bridge in its input. In Figure 3, the acutal components are represented by a simplified pictorial, in which the generator "G" is representative of a constant current supply and a 60 cycle shunt chopper. The detector "D" represents a high common mode rejection differential amplifier error detector system. The resistance arms R1 thru R4 represent the components in the actual bridge arms. Figure 4 shows the actual components in the bridge. At this point note should be made that there are two small anitcipator resistances located in the bridge circuitry. Their magnitude is approximately 10 ohms, and one is located in series with bridge arm R3 while the other is located in series with the probe arm R4. They will be ignored in this discussion as they compensate each other.

5.1.2 The detector "D" is a null (bridge balanced) when the cross products of the bridge arms are equal.

$$R1 \times R4 = R2 \times R3$$

Rearranging terms, we have

$$R4 = \frac{R2}{R1} \times R3$$

If R1 = R2, the bridge balance equation is then R4=R3.

5.1.3 In the actual bridge (Figure 4) R4 is the equivalent temperature probe resistance. A fixed precision resistor, located on the Controller board (905.5 ohms) is in parallel with the actual probe resistance of 140 ohms (typical value at -73°C). The equivalent R4 then becomes

$$\frac{140 \times 906}{140 + 906} = 121 \text{ ohms}$$

Since the fixed resistor is out of the temperature environment, the equivalent resistance will be referred to as probe resistance in the remaining discussion. The expression then becomes approximately equal to

$$121 \text{ ohms} + \left(\frac{.783 \text{ ohms}}{^{\circ}C}\right) \times \triangle t$$

where $\triangle t$ is the number of °C above the lowest temperature that the system is set up for (typically -73°C). Thus, a value for the probe resistance at 25°C is

$$121 \text{ ohms} + \frac{.783 \text{ ohms}}{^{\circ}C} \times \left[25^{\circ}C - (-73^{\circ}C)\right]$$

(cont)

$$= 121 \text{ ohms} + \frac{.783 \text{ ohms}}{^{o}C} \times 98^{o}C$$

$$= 121 \text{ ohms} + 76.7 \text{ ohms}$$

$$= 197.7 \text{ ohms}$$

The probe circuit is linearized and approximates a straight line quite nicely.

5.1.4 For the bridge to be in balance at 25°C, the value of resistance arm R3 must also be equal to 197.7 ohms. The 20 turn trim pot and the 107 ohm fixed resistor sum is adjusted to 121 ohms (which is the value of the probe resistance at the lowest system temperature, -73°C). Thus, the value of the resistance of the TEMPERATURE SET potentiometer for bridge balance at 25°C would be 76.7 ohms. This 76.7 ohms is the increase in resistance of the probe above its "lowest" value.

5.1.5 The bridge balance relationship can be expressed as

$$R3 = R4$$

for T = 25°C

121 ohms	+	76.7 ohms	=	121 ohms	+	76.6 ohms
Fixed Offset Resistance		TEMP SET pot., Programmed Resistance, or X-1 option resistance.		Probe Resistance at -73°C (lowest system temperature)		Probe resistance increase due to difference in temperature between -73°C and +25°C

The above is great for a "perfect probe" and a "perfect" TEMPERATURE SET potentiometer which in real life are quite difficult to obtain (at least at a reasonable production cost). Consequently, both SLOPE and OFFSET adjustments are provided in the bridge to compensate for variations in the potentiometers and probes.

5.1.6 The SLOPE adjustment is a 100 ohm trim pot and allows the magnitude of R2 to be adjusted. The complete bridge balance equation is

$$R1 \times \underbrace{R4}_{\text{Probe}} = R2 \times \underbrace{R3}_{\text{Temp Select}}$$

$$\text{or } R4 = \left(\frac{R2}{R1}\right) \times \underbrace{R3}_{\text{Temp Select}}$$

Thus $(\frac{R2}{R1})$ can be thought of as an adjustable constant, where it is the ratio of two resistances and can be considered as a scaling factor "k".

$$R4 = k \times R3$$

The value of "k" is adjustable by changing the setting of the SLOPE potentiometer in Figure 4. It is adjustable between .883 and 1.05.

$$k = \frac{R2}{R1} = \frac{530 \text{ ohms}}{600 \text{ ohms}} = .883$$

$$k = \frac{R2}{R1} = \frac{630 \text{ ohms}}{600 \text{ ohms}} = 1.05$$

Thus the relationships between the temperature selection circuitry (R3) and the temperature probe (R4) may be adjusted by means of the SLOPE potentiometer. The SLOPE potentiometer is adjusted so as to produce the proper increase in temperature in the system as the temperature is selected by the TEMPERATURE SET potentiometer.

5.1.7 The OFFSET potentiometer is the 20 turn 20 ohm unit and is used to calibrate the bridge for the base resistance of the probe and the "end" resistance of the TEMPERATURE SET potentiometer when it theoretically should be zero at the lowest temperature setting of the system.

5.1.8 A series of figures, representing the relationships between the TEMPERATURE SET dial settings, the actual system temperatures produced and the effect of adjustments of both the SLOPE and OFF-SET potentiometer is included as Figure 5, 6 and 7.

Figure 5 is the Temperature Set vs. System Temperature Transfer Plot and depicts, by the line A A', the proper adjustments of both SLOPE and OFFSET, so as to give proper system temperatures corresponding to the dial settings. Figure 6 shows the effect of changing the OFFSET adjustment in the bridge.

NOTE: CHANGING THE OFFSET DOES NOT CHANGE THE SLOPE OF THE TRANSFER A A'.

Figure 7 shows the effect of changing the SLOPE ADJUSTMENT in the brige.

NOTE: CHANGING THE SLOPE ADJUSTMENT DRASTICALLY EFFECTS THE OFFSET.

Because of the non-interaction of the OFFSET on the SLOPE and the radical interaction of the SLOPE on the OFFSET, first obtain the proper slope adjustment then as a final step, make the OFFSET adjustment when calibrating the Type III controller bridge. Refer to paragraph 5.2 for calibration procedures.

5.2 Temperature Chamber Calibration Data

5.2.1 A tabulation of resistance values, for two temperatures, 65.6°C and 204°C, for each of the types of Delta Design chambers is included here. The differences in resistance values are due to the differences in temperatures between the center of the chamber and location of the probe for each model. Using these figures in the calibration usually results in temperature within 2°C of temperature desired.

TEMPERATURE CHAMBER CALIBRATION DATA

CHAMBER	TEMPERATURE SET	EQUIVALENT PROBE RESISTANCE WITH 905.5 (R65) MOUNTED ON PC BOARD C2637594	EQUIVALENT PROBE RESISTANCE WITHOUT 905.5 (R65) MOUNTED ON PC BOARD C2637594
2300	150°F or 65.6°C	310.3 ohm	231.8 ohm
	400°F or 204°C	544.4 ohm	340.4 ohm
2850	150°F or 65.6°C	310.8 ohm	232.0 ohm
	400°F or 204°C	540.3 ohm	340.3 ohm
3900	150°F or 65.6°C	311.5 ohm	232.1 ohm
	400°F or 204°C	544.0 ohm	342.1 ohm
4115	150°F or 65.6°C	315.4 ohm	-
	400°F or 204°C	563.0 ohm	-
4135 & 4145	150°F or 65.6°C	310.6 ohm	-
	400°F or 204°C	557.4 ohm	-
5900	150°F or 65.6°C	312.3 ohm	232.6 ohm
	400°F or 204°C	554.3 ohm	346.3 ohm
6400	150°F or 65.6°C	311.5 ohm	232.1 ohm
	400°F or 204°C	550.2 ohm	342.5 ohm
7600 & 7650	150°F or 65.6°C	311.4 ohm	232.8 ohm
	400°F or 204°C	545.7 ohm	345.3 ohm
8000 HOT	150°F or 65.6°C	312.1 ohm	-
	400°F or 204°C	550.3 ohm	-
8000 COLD	150°F or 65.6°C	163.6 ohm	-
	400°F or 204°C	550.3 ohm	-
8070, 8071 & 8073	-85°F or -65°C	126.6 ohm	-
	290°F or 143°C	292.0 ohm	-
8195	-85°F or -65°C	130.3 ohm	-
	290°F or 143°C	288.2 ohm	-

5.3 Calibration Procedure - Type III - General - Once the Controller has been initially calibrated, periodic calibration is not normally required. The following procedure may be used when calibration is necessary. The required equipment will be an oscilloscope and precision resistor substitution box such as a General Radio Co. type 1432-T.

WARNING

THE CASE OF THE TRIAC SWITCH ASSEMBLY, LOCATED ON THE CONTROLLER SUBASSEMBLY, IS AT POWER LINE POTENTIAL AND EXTREME CARE IN SERVICING OR CALIBRATION MUST BE EXERCISED.

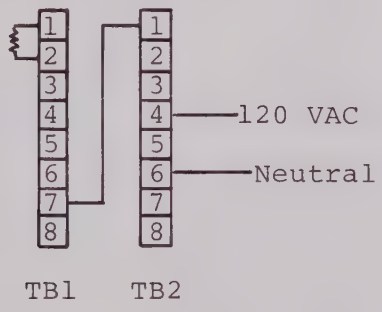
5.3.1 Preparation:

5.3.1.1 Ensure that the Controller HEAT, COOL and POWER switches are in the off position and if the Controller is mounted in a temperature chamber or handler, main power is removed from the unit.

5.3.1.2 Remove the Controller from the chamber or handler and disconnect all electrical connections from TB-1 and TB-2 at the rear of the Controller. Mark cable connections for reconnection.

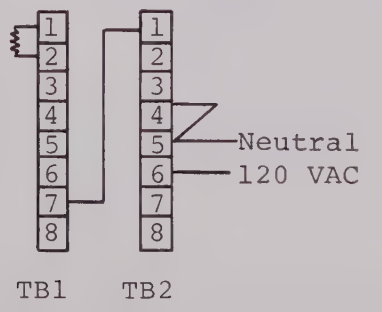
5.3.1.3 Make connections to TB-1 and TB-2 on the bench as follows:

Model A1160 (120V)



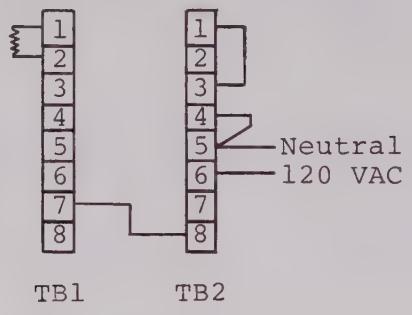
(a) Resistor substitution box between TB1-1 and TB1-2.
(b) Jumper between TB1-7 and TB2-1.
(c) 120 VAC into TB2-4 and TB2-6.

Model A1161 (240V)



(a) Resistor substitution box between TB1-1 and TB1-2.
(b) Jumper between TB1-7 and TB2-1.
(c) Jumper between TB2-4 and TB2-5.
(d) 120 VAC into TB2-5 and TB2-6.

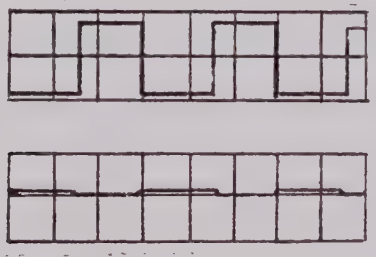
Model A1172 (240V)



(a) Resistor substitution box between TB1-1 and TB1-2.
(b) Jumper between TB1-7 and TB2-8.
(c) Jumper between TB2-1 and TB2-2.
(d) Jumper between TB2-4 and TB2-5.
(e) 120 VAC into TB2-5 and TB2-6.

5.3.1.4 Connect the oscilloscope to R45 at location shown on C2637594. Connect the Ground of the scope to the chassis.

Scope setting: 10V/Cm 5ms/Cm



Out of Null

Null

Waveform Example

5.3.2 General Calibration Procedure:

5.3.2.1 Switch the Controller POWER switch to the ON position.

5.3.2.2 Set the resistor substitution box to the equivalent probe resistance for 65.6°C as shown in the table in paragraph 5.2.

5.3.2.3 Adjust the TEMPERATURE SET until a null condition occurs. Note whether the setting is above or below 65.6°C.

5.3.2.4 Set the dial at 65.6°C.

5.3.2.5 If the null setting occurred below 65.6°C, adjust the OFFSET potentiometer (R11) counterclockwise (refer to Figure 2) until a null condition occurs.

5.3.2.6 If the null setting occurred above 65.6°C, adjust the OFFSET potentiometer (R11) clockwise until a null condition occurs.

5.3.2.7 Set the resistor substitution box to the equivalent probe resistance for 204°C as shown in the table in paragraph 5.2.

5.3.2.8 Adjust the TEMPERATURE SET until a null condition occurs. Note whether the setting occurs above or below 204°C.

5.3.2.9 Set the dial to 204°C.

5.3.2.10 If the null setting occurred below 204°C, adjust the SLOPE potentiometer (R33) (refer to Figure 2) counterclockwise until a null condition occurs.

5.3.2.11 If the null setting occured above 204°C, adjust the SLOPE potentiometer (R33) clockwise until a null condition occurs.

5.3.2.12 Repeat step 5.3.2.2 through 5.3.2.6 and 5.3.2.7 through 5.3.2.11 alternately as many times as necessary to achieve a null condition at each dial setting vs. the recommended values in the table (paragraph 5.2).

5.3.2.13 Turn off power source, remove bench connections and reinstall Controller in applicable unit (chamber or handler).

5.4 Specific Calibration - The calibration procedure and values outlined in paragraph 5.3 for Controller alignment are only approximate and consist of the average values assuming perfect matching of the TEMPERATURE SET potentiometer and the temperature probe.

After the Controller is adjusted to a "ballpark" calibration by means of the general procedure as outlined in paragraph 5.3, it can be very precisely calibrated by means of an additional procedure. This procedure, performed with the Controller installed and TB1 and TB2 reconnected, is desirable for systems requiring very accurate temperature control.

5.4.1 Procedure: Refer to an use the Calibration Work Sheet on page 16.

5.4.1.1 Install another temperature sensor (thermocouple, RTD, or thermistor) with the proper sensor leads in the center of the workspace of the chamber and close the chamber door. Connect the leads to the appropriate pyrometer or other suitable temperature measuring device. Set the MODE switch to MANUAL.

5.4.1.2 Switch the POWER, HEAT and COOL switches to the ON position.

5.4.1.3 Adjust the TEMPERATURE SET to the lowest temperature setting of interest. Record the setting on the work sheet at (a).

5.4.1.4 Allow the system to stabilize and record at (b) the temperature indicated on the measuring device, which is being used as the reference. (This reading will henceforth be referred to as the "acutal temperature").

5.4.1.5 Adjust the TEMPERATURE SET to the highest temperature setting of interest and record setting at ⓒ.

5.4.1.6 Allow the system to stabilize and record the actual temperature at ⓓ.

5.4.1.7 Switch the POWER switch to the OFF position and remove the probe input leads to the Controller. These are terminals 1 and 2 of TB1 on the Controller. These are the two top terminals of the left hand board looking at the rear of the unit from the back. Notice which wire goes to which terminal so they can be put back as originally connected. Connect a resistor substitution box (such as General Radio Type 1432-T) between these two terminals on the rear of the Controller.

5.4.1.8 Connect an oscilloscope to R45 at the point shown on the printed circuit board assembly drawing C2637594. Connect the ground of the oscilloscope to any portion of the Controller frame.

5.4.1.9 Switch the HEAT and COOL switches to the OFF position and the POWER switch to the ON position.

5.4.1.10 Adjust the TEMPERATURE SET to the reading recorded at ⓐ.

5.4.1.11 Adjust the resistor substitution box until a null occurs on the scope and record the resistance figure at ⓔ.

5.4.1.12 Adjust the TEMPERATURE SET to the reading recorded at ⓒ.

5.4.1.13 Adjust the resistor substitution box until a null occurs on the scope and record the resistance value at ⓕ.

5.4.1.14 Adjust the TEMPERATURE SET to the actual temperature ⓓ and adjust the resistor substitution box to resistance ⓕ.

5.4.1.15 Adjust the SLOPE potentiometer (R33) (refer to Figure2) until a null occurs.

5.4.1.16 Adjust the TEMPERATURE SET to the actual temperature ⓑ and adjust the resistor substitution box to resistance ⓔ.

5.4.1.17 Adjust the OFFSET potentiometer (R11) (refer to Figure 2) until a null occurs.

5.4.1.18 Repeat steps 5.4.1.14 through 5.4.1.17 until a null occurs at:

TEMPERATURE SET	Resistor Substitution Box
ⓓ temperature	ⓕ resistance
ⓑ temperature	ⓔ resistance

5.4.1.19 The system is now calibrated. Verify the calibration by turning off the power, disconnecting the resistance box and reconnecting the controller to the applicable temperature chamber or handler. Set the TEMPERATURE SET to a test temperature. Turn on POWER, HEAT and COOL. Allow the chamber to stabilize and verify that the actual temperature does indeed reflect what was set on the dial.

CALIBRATION WORK SHEET

	Temp Set Indicator	Actual Temp	Actual Probe Resistance
(c)	_____	(d) _____	(f) _____
(a)	_____	(b) _____	(e) _____

5.5 Calibration Procedure - Controllers with X-1 Option - After the precise calibration, paragraph 5.4, has been accomplished, proceed as follows:

5.5.1 Ensure that the POWER switch is in the off position and remove the probe input leads to the Controller. These are terminals 1 and 2 of TB1 on the Controller. Notice which wire goes to which terminal so they can be put back as originally connected. Connect a resistor substitution box (such as General Radio Type 1432-T) between these two terminals on the rear of the Controller.

5.5.2 Connect an oscilloscope to the point on R45 as ahown on the printed circuit board assembly drawing C2637594. Connect the ground of the oscilloscope to any portion of the Controller frame.

5.5.3 Adjust the TEMPERATURE SET to the setting which corresponds to the first preset temperature to be calibrated.

5.5.4 Switch the POWER switch to on and leave the HEAT and COOL switches off.

5.5.5 Adjust the resistor substitution box until a null occurs on the scope.

5.5.6 Rotate the MODE switch clockwise past the PROGRAM position to engage the first preset position to be calibrated.

5.5.7 Alternately adjust the coarse and fine trimpots mounted on the P.C. Board A1442 (Reference drawing C2638511) until a null occurs. Adjust the potentiometers which correspond to the position of the MODE switch (numbered one thru ten).

5.5.8 Repeat steps 5.5.3 thru 5.5.7 using all the setpoints progressing through the switch positions until all of the positions have been calibrated.

5.5.9 Before testing any materials at test temperatures, run the chamber at the preset temperatures and perform any fine adjustments necessary for exact temperature calibration using the fine trimpots.

5.5.10 After calibration is complete, disconnect the resistor substitution box and reconnect the chamber temperature probe leads. Reinstall the Controller in the applicable unit (chamber or handler).

6 TROUBLE SHOOTING

6.1 General

6.1.1 The following factors will aid the trouble shooting procedures.

(a) The red HEAT lamp is connected across the Controller heat output. A steadily illuminated red lamp is an indication that the heaters are being energized.

(b) The green COOL lamp is connected directly across the coolant valve solenoid and when steadily illuminated, indicates power is being applied to the solenoid.

(c) Turning the MODE switch to the PROGRAM position, with the safety plug connected, should extinguish both the HEAT and COOL lamps.

6.1.2 Waveforms and DC voltages are shown on the Control Board Schematic Diagram D1635619 and should be checked for difficult cases.

6.1.3 Refer to the electrical trouble shooting chart (Figure 8) for chamber/controller related problems.

6.2 Anticipator Wire Replacement

6.2.1 Should the anticipator wire (R34 or R58) on PC Board Assembly C2637594 become damaged or broken, replacement may be accomplished as follows:

6.2.1.1 Remove any remaining portions of the old broken wire.

6.2.1.2 Wrap new wire snuggly around resistor as shown in Figure 9. Take care not to stretch the wire. Solder the wire to the turret terminals as shown. Measurement across the anticipator terminals resistance shall be 9.0 to 11.0 ohms.

7 WARRANTY

Delta Design, Inc. guarantees all products manufactured and sold by it to conform to published specifications and against defective material and workmanship for a period of 90 days from the date of our shipment. Temperature chambers and electronics are warranted for one year from date of shipment. All contactor assemblies are warranted for a period of 90 days or 1/2 million cycles. Obligation under these warranties is limited to repair or replacement by Delta at its plant or one of its authorized service stations, on any of our products which Delta determines to be defective or not in accord with stated specifications. Delta will not accept responsibility for any defect caused by improper use, nor will Delta assume liability for any unauthorized repairs or modifications to its products or materials, even though defective or not in accord with the specifications. In no case will responsibility extend to products, materials, or equipment not manufactured by Delta. All products to be returned to Delta's plant for warranty repair must have prior written approval from Delta Design, Inc., and all return transportation charges will be at the buyer's expense. Delta will not accept liability for any unauthorized returns. No liability will be accepted for any damages to customer's materials, and equipment due to the use or misue of Delta's products, nor for any loss of profits or other special damages. Delta Design, Inc., reserves the right to change price, design features and/or specifications without notice.

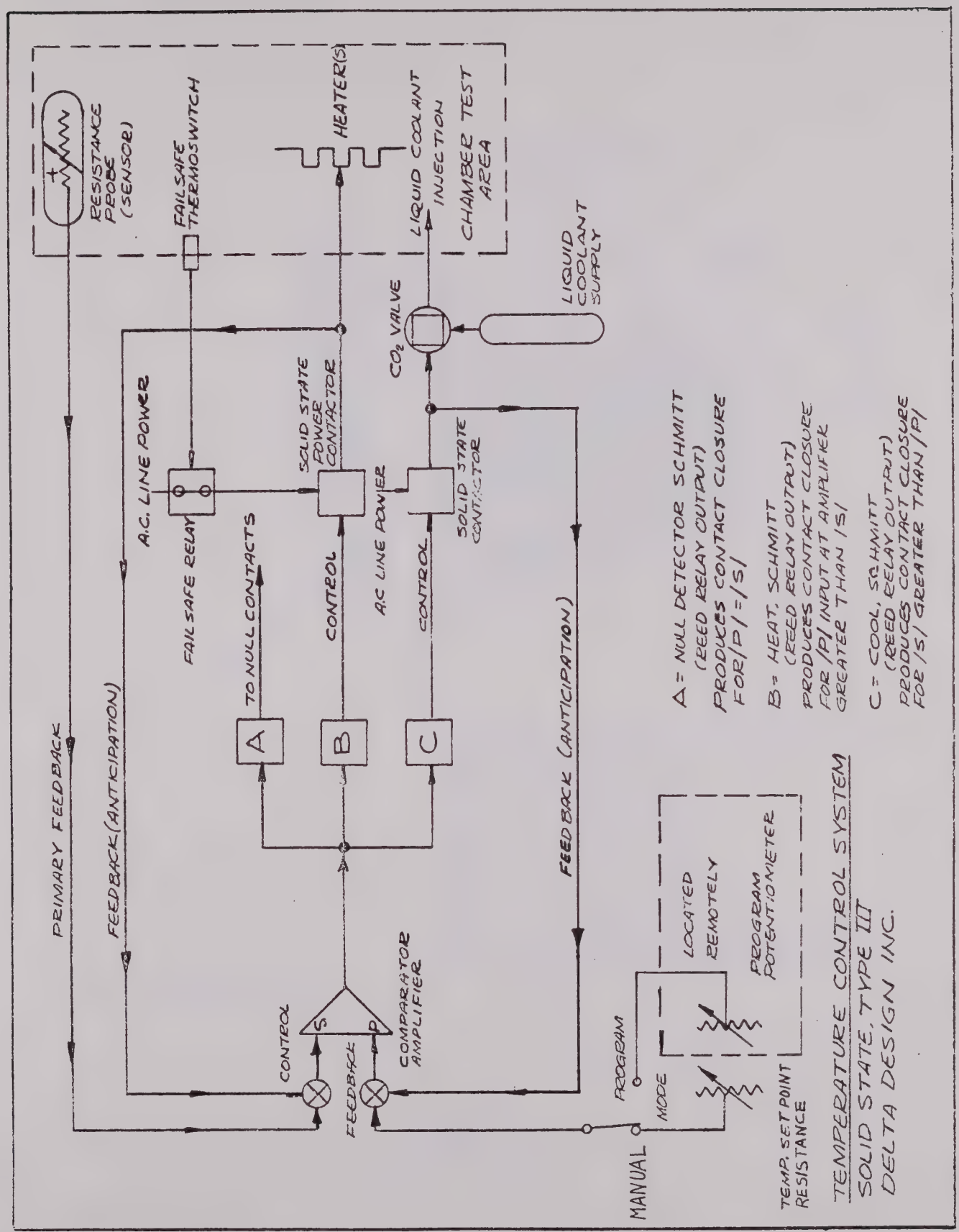
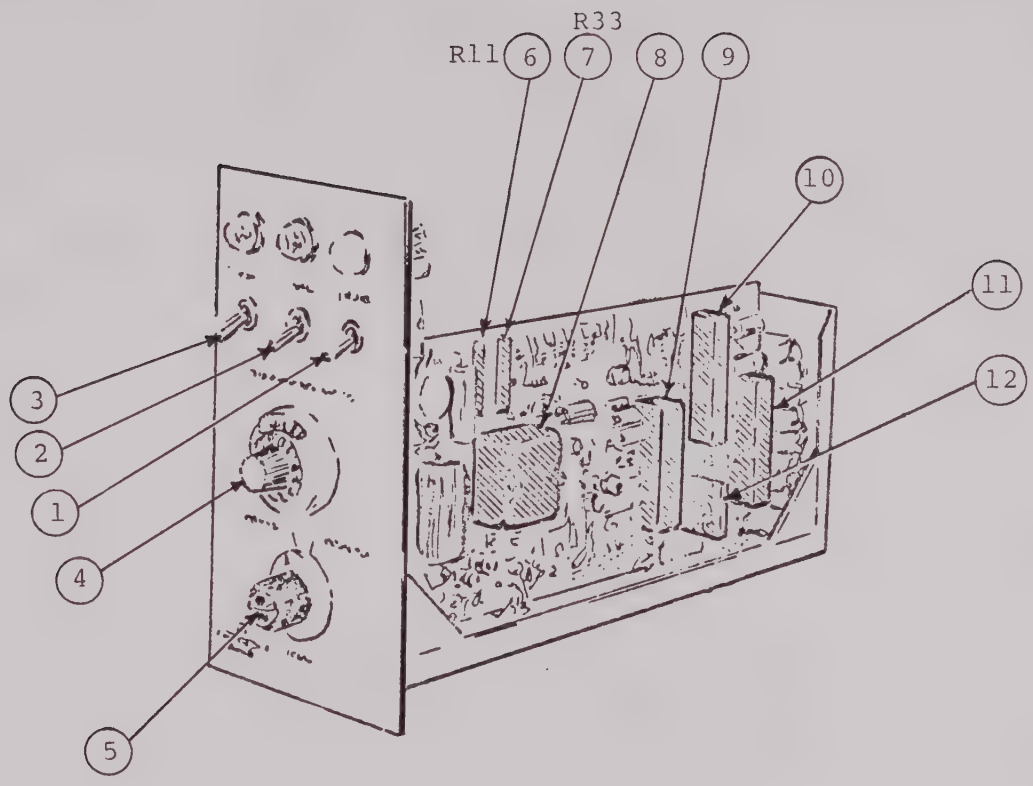


FIGURE 1
Temperature Control System



1. POWER On/Off Switch
2. COOL On/Off Switch
3. HEAT On/Off Switch
4. TEMPERATURE SET POINT Dial & Pot
5. MODE Selector
6. Temperature OFFSET Potentiometer (R11)
7. SLOPE Adjustment Potentiometer (R33)
8. Anticipator Cover
9. HEAT - Reed Relay
10. COOL - Reed Relay
11. NULL - Reed Relay
12. Silicon Controlled Rectifier and Bracket

FIGURE 2
Component Location

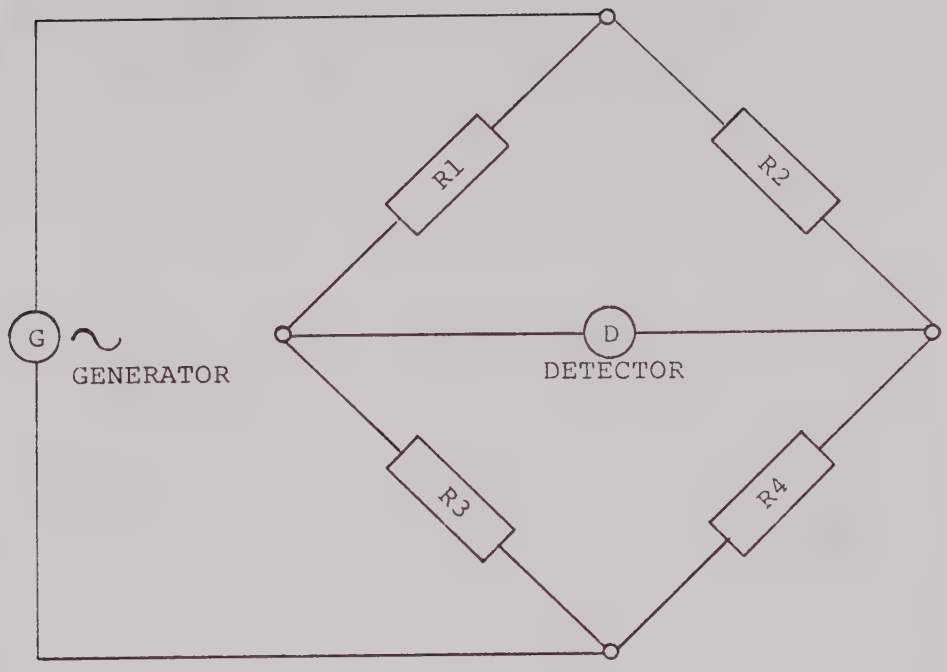


Figure 3
Four Arm Bridge

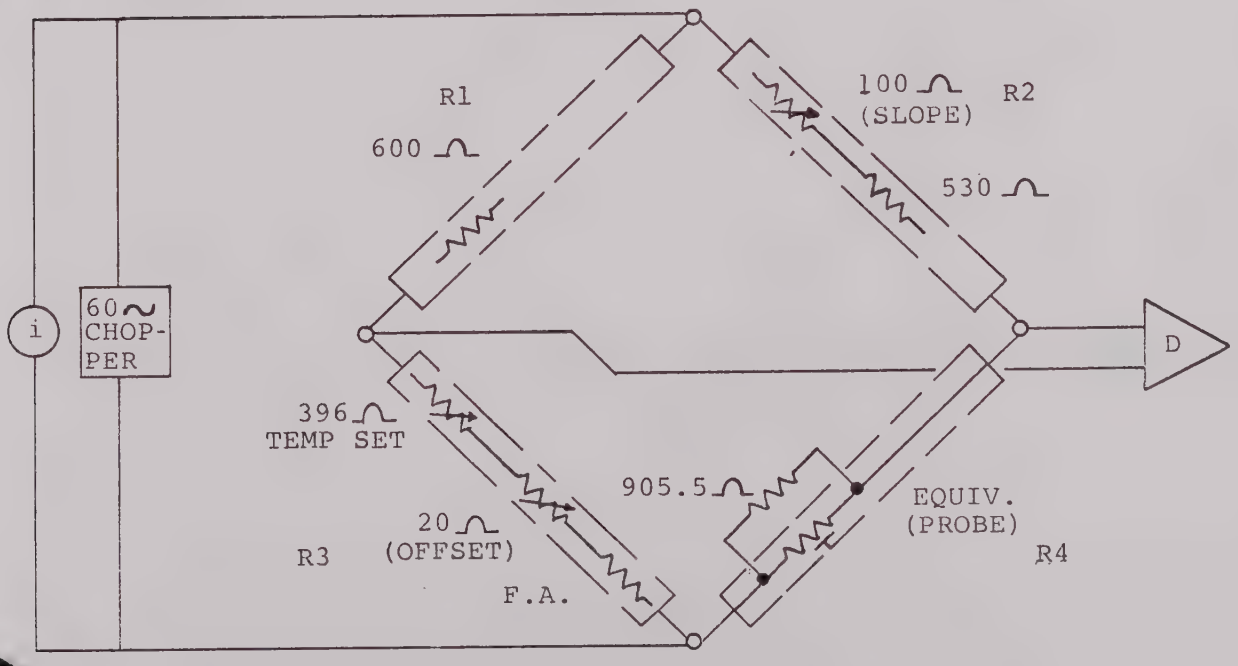


Figure 4
Bridge Components

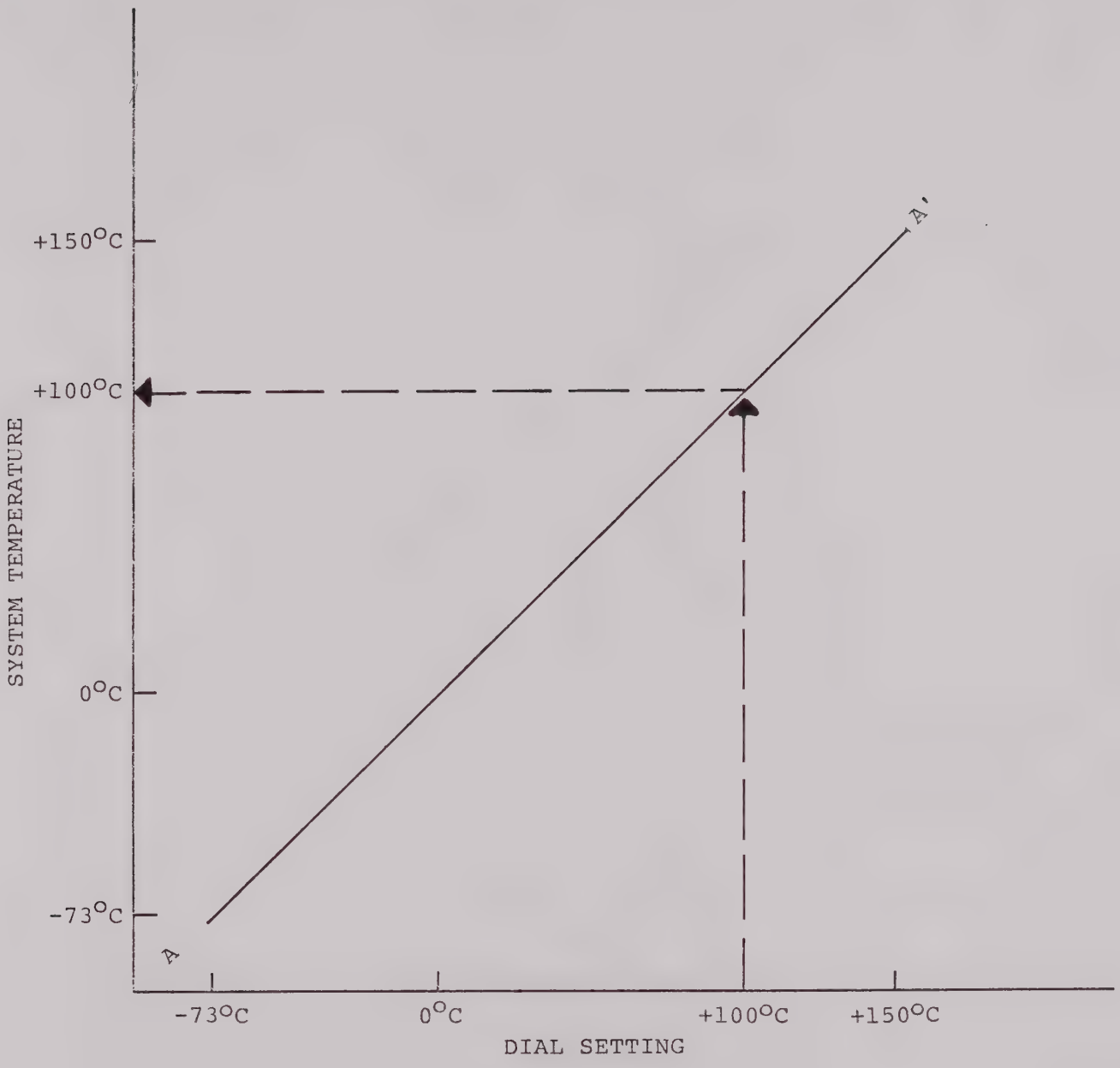


Figure 5
Temperature Set vs System Temperature
Transfer Plot

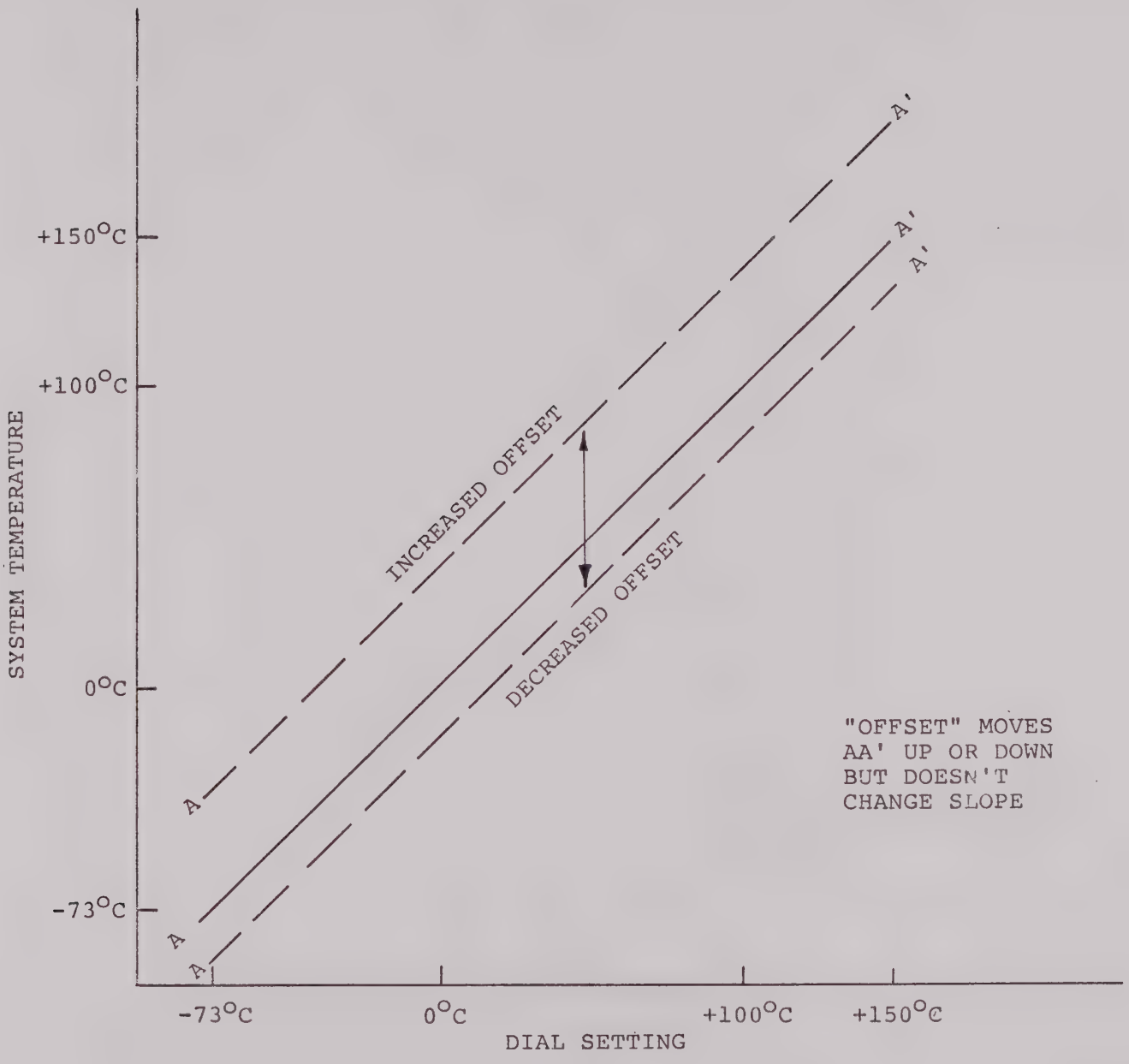


Figure 6
Effect of OFFSET Adjustment on
System Transfer Characteristics

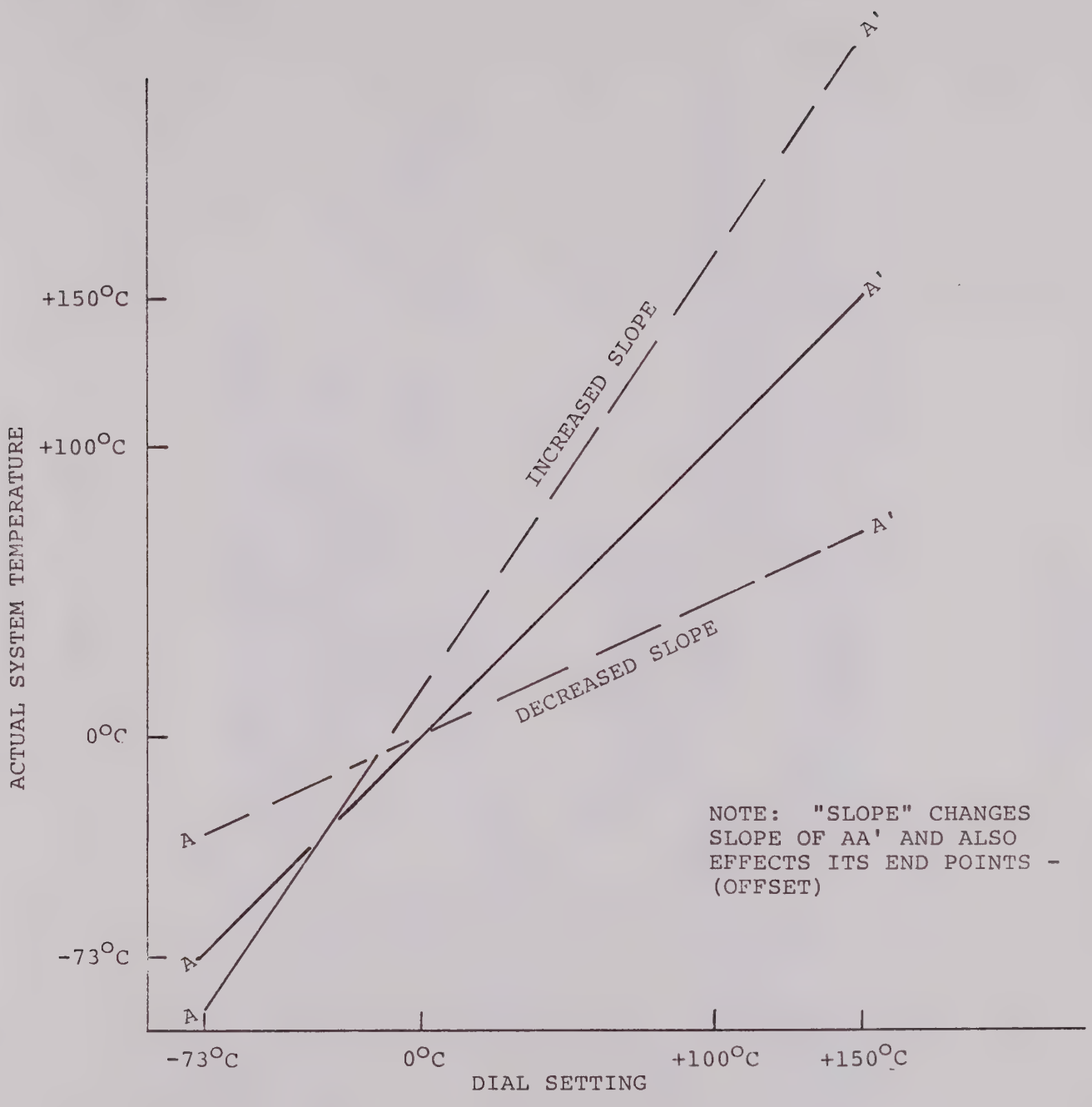


Figure 7
Effect of SLOPE Adjustment on
System Transfer Characteristics

TROUBLE SHOOTING: ELECTRICAL

HOW TO USE THIS CHART

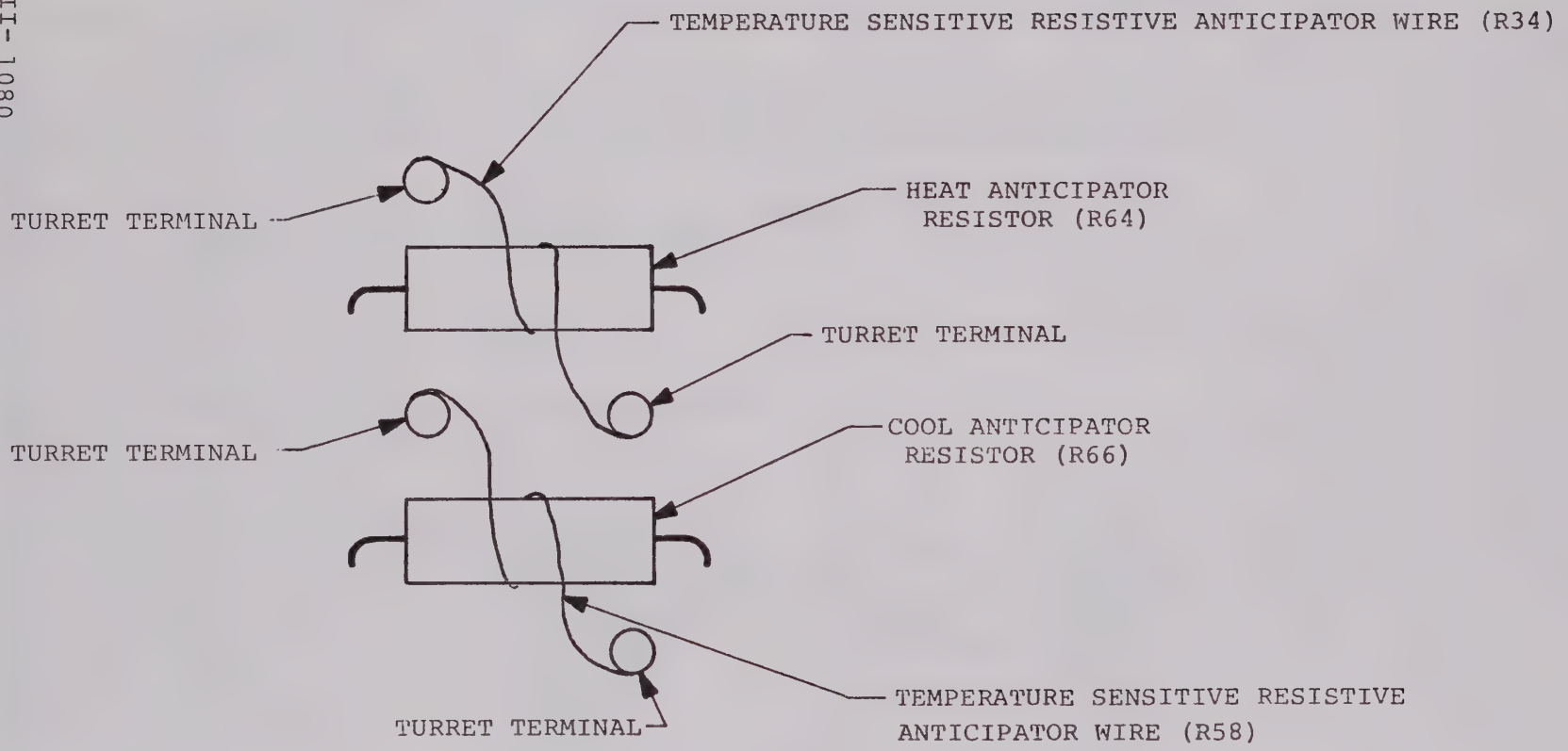
1. Turn Mode Switch to Manual.
2. Note Thermometer Reading (Chamber Temperature)
3. Turn Heat and Cool Switches On.
4. Turn Temperature Set Control 50° Higher than Chamber Temperature and note the conditions of the Heat and Cool Lamps.
5. Turn Temperature Set Control 50° Lower than Chamber Temperature and note the conditions of the Heat and Cool Lamps.

These two situations determine the correct block to read in the chart:

6. Enter the Chart at the Top for the conditions observed in step 4. (50° Higher than Chamber Temperature.)
7. Enter the Chart at the Left Side for the conditions observed in step 5. (50° Lower than Chamber Temperature.)

		LIGHT STATE WITH TEMPERATURE SET DIAL 50° HIGHER THAN CHAMBER TEMP.			
LIGHT STATE WITH TEMPERATURE SET DIAL 50° LOWER THAN CHAMBER TEMP.		RED - OFF GREEN - OFF	RED - ON GREEN - OFF	RED - OFF GREEN - ON	RED - ON GREEN - ON
	RED - OFF GREEN - OFF	Probe Element shorted to case. (Replace) Failure on Amplifier P.C. Board. (Trace signal with scope) Transformer Winding open.	Cool Circuit has failed. Trace signals with scope.		
	RED - ON GREEN - OFF		Probe shorted out. Temp. set Pot. — open. Cool Anticipator winding open. Check between Terminal A and Case of Q8 for 10Ω.		
	RED - OFF GREEN - ON	Failsafe Relay K1 not energizing. Coil resistance will be Approx. 10K. Failsafe open. Heat Triac failed.	NORMAL	Probe Open. Temp. Set. Pot. shorted. Heat Anticipator Winding open: Check between B and Case of Q9 for 10Ω.	Cool Circuit has failed — Trace signal with scope.
	RED - ON GREEN - ON		Heat circuit has failed — Trace signal with scope. Triac failed.		

Figure 8



Remove the cover to expose anticipators.
Wrap the anticipator wire snuggly around the 8.2K resistors (R64 and R66).
Take care not to stretch the wire and solder to the turret terminals as shown.
Measure the resistance. Value should be between 9.0 to 11.0 Ohms.

FIGURE 9
Anticipator Wire Replacement
(PC Assembly Type III Controller C2637594)

11182

P.L. 1648289 REV B SHT 1 OF 2

DESCRIPTION: CONTROLLER ASSY TYPE III MODEL A1160

NEXT ASSY: END ITEM BY: [illegible] 10-6-82 CK'D: APPD:

REV	ECN	DATE	BY	APP
B	303	11-2-82	[illegible]	

DELTA DESIGN
5725 KEARNY VILLA RD.
SAN DIEGO, CALIF.

JOB NO. S.O. NO.
QTY PROM DATE ACT
RUN * MACH

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO.	STOCK OR PART NO.	JOB QTY	AUL	QTY REC	FAB CD	PURCHASING P.O. NO	QTY DUE	REC	MANUFACTURE ACT STD HRS	EST ACT COM	ACT COM	PLATE/PAINT IN	OUT	AREA
00	X				P/L	1648289		CONTROLLER, TYPE III, MODEL A1160-1 (120V, -100°TO+600°F)		1648289-001														
00		X			P/L	1648289		CONTROLLER TYPE III MODEL A1160-3 (120V, -73°TO +315°C)		1648289-002														
00			X		P/L	1648289		CONTROLLER TYPE III MODEL A1160-11 (120V -184°TO+315°C)		1648289-003														
00																								
00																								
00	REF				D	1635617		SCHEMATIC CONTROLLER TYPE III	120V															
00	REF	REF	REF		C	2638511		X1 OPTION ASSY																
00																								
00																								
00																								
00																								
00																								
00	REF	REF	REF		D	1635619		SCHEMATIC CONTROL BD																
00																								
00																								
00																								
00																								
01	1	1	1		C	2637594		CONTROL BD ASSY		2637594														
02	1	1	1					TERMINAL, BLOCK 2 PIN	CINCH JONES 2-140	1400508														
03	1	1	1					RESISTOR 3.3K OHM 1/2 W 5%		0303320-500														
04	1	1	1					TERMINAL, STRIP	SMITH 1088	1400505														
05	1	1	1					TRANFORMER	SPARTON 1201A-8	1400299														
06	18	18	18					NUT, SWAGE		1700028														
07	2	2	2					GROMMET		1500026														
08	4	4	4					STANDOFF		4100092														
09	2	2	2					WASHER, #6 FLAT		6606000														
10	A/R	A/R	A/R					WIRE, AWG 20		1500389														
11	A/R	A/R	A/R					TIE CORD		1501379														
12	6	6	6					LUG		1500065														
13	6	6	6					LUG		1500055														
14	A/R	A/R	A/R					WIRE AWG 18		1500388														
15	1	1	1				1600236		CHASSIS		1600236-001													
16	1	1	1				1600261		BRACKET		1600261-001													

NOTES: 1. THIS CONTROLLER IS VERTICAL & 120V.
2. REF - FOR THERMOCOUPLE B1650230 SEE DRAWING AND P/Ls D1650238 & D1650223.
3. FOR OTHER TYPE III CONTROLLERS, MODELS - A1161 & A1172 SEE P/Ls 1654798 AND 1654799

1648289 P/L REV B

28

P/L 1648289 REV B SHT 2 OF 2

DESCRIPTION CONTROLLER ASSY TYPE III MODELAIR

NEXT ASSY END ITEM BY [illegible] CK'D ____ APPD ____

REV	ECN	DATE	BY	APP

DELTA DESIGN
5725 KEARNY VILLA RD
SAN DIEGO, CALIF

JOB NO ____ SO NO ____
QTY ____ PROM DATE ____ ACT ____
RUN * ____ MACH ____

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO	STOCK OR PART NO.	JOB QTY	AUL	QTY REC	FAB CD	PURCHASING P.O. NO	QTY DUE REC	MANUFACTURE ACT STD HRS	EST ACT COM	COM	PLATE/PAINT IN	OUT	AREA
17	8	8	8						RIVET		1700051												
18	2	2	2						TERMINAL BLOCK 8 PIN	KULKA K699	1400520												
19	2	2	2						SWITCH		1400181												
20	1	1	1						SWITCH - MODE	IRC T207	1400189												
21	1	1	1						SWITCH		1400157												
22	1	1	1						DIAL	AMPHENOL 1323	1500784												
23	1	1	1				1600464		PANEL, CONTROL		1600464-001												
24	1	1	1						LENS, GREEN		1400090												
25	1	1	1						LENS, WHITE		1400091												
26	1	1	1						LENS, RED		1400092												
27	3	3	3						HOLDER, LAMP	SYLVANIA 30099-0	1400076												
28	1	1	1						KNOB		1500279												
29	3	3	3						LAMP	SYLVANIA 120 PSB	1400084												
30		1							SPACING RING (POT)		1500018												
31		1							POT	VOAK D-11	0500018												
32	1	1	1			B	1654248		RELAY ASSY, SOLID STATE		1654248-001												
33																							
34																							
35																							
36	AR	AR	AR						SCREW *4-40 x 3/8		6804403-824												
37																							
38																							
39	AR	AR	AR						SCREW *6-32 x 1/2		6806321-224												
40	AR	AR	AR						SCREW *6-32 x 3/8		6806323-324												
41																							
42	AR	AR	AR						NUT *6-32		6706320-000												
43																							
44																							
45																							
46	1								POT		0500034												
47			1						POT		0500015												

NOTES:

P/L 1648289 REV B

1182

P/L 1654798 REV N/C SHT 1 OF 2

DESCRIPTION CONTROLLER ASSY TYPE III MODEL A1161

NEXT ASSY END ITEM BY [illegible] 10-8-82 CK'D ____ APPD ____

REV	ECN	DATE	BY	APP
—	3242	[illegible]	[illegible]	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—

DELTA DESIGN
5725 KEARNY VILLA RD
SAN DIEGO, CALIF

JOB NO ____ S.O. NO. ____
QTY ____ PROM DATE ____ ACT ____
RUN * ____ MACH ____

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO	STOCK OR PART NO.	JOB QTY	AUL	QTY REC	FAB CD	PURCHASING PO NO	QTY	DUE	REC	MANUFACTURE ACT STD HRS	EST ACT COM	COM	PLATE/PAINT IN	OUT	AREA
00	X					P/L	1654798		CONTROLLER TYPE III MODEL A1161-	1(240ᵛ -100 TO +600°F)	1654798-001														
00		X				P/L	1654798		CONTROLLER TYPE III MODEL A1161-3	(240ᵛ -73° TO +315°C)	1654798-002														
00			X			P/L	1654798		CONTROLLER TYPE III MODEL A1161-	11(240ᵛ -184° TO+ 315°C)	1654798-003														
00																									
00																									
00	REF	REF	REF			D	1635618		SCHEMATIC CONTROLLER TYPE III	240ᵛ															
00	REF	REF	REF			D	1635619		SCHEMATIC CONTROL BD																
00																									
00	REF	REF	REF			C	2638511		x 1 OPTION ASSY																
00																									
00																									
00																									
01	1	1	1			C	2637594		CONTROL BD ASSY		2637594														
02	1	1	1						TERMINAL BLOCK 2 PIN	CINCH JONES 2-140	1400508														
03	1	1	1						RESISTOR 3.3K OHM 1/2W 5%		0303320-500														
04	1	1	1						TERMINAL, STRIP	SMITH 1088	1400505														
05	1	1	1						TRANFORMER	SPARTON 1201A-8	1400299														
06	18	18	18						NUT SWAGE		1700028														
07	2	2	2						GROMMET		1500026														
08	4	4	4						STANDOFF		4100092														
09	2	2	2						WASHER #6 FLAT		6606000														
10	A/R	A/R	A/R						WIRE #AWG 20		1500389														
11	A/R	A/R	A/R						TIE CORD		1501379														
12	6	6	6						LUG		1500065														
13	6	6	6						LUG		1500055														
14	A/R	A/R	A/R						WIRE AWG #18		1500388														
15	1	1	1				1600236		CHASSIS		1600236-001														
16	1	1	1				1600261		BRACKET		1600261- [illegible]														
17	8	8	8						RIVET		1700051														
18	2	2	2						TERMINAL BLOCK 8 PIN	KULKA K699	1400520														
19	2	2	2						SWITCH		1400181														
20	1	1	1						SWITCH - MODE	IRC T207	1400187														
21	1	1	1						SWITCH		1400157														

NOTES: 1. THIS CONTROLLER IS VERTICAL @ 240ᵛ
2. REF - FOR THERMOCOUPLE B1650230 SEE DRAWINGS AND P/Ls D1650238 & D1650223

1654798
P/L

30

1182

PL 1654798 REV N/C SHT 2 OF 2

DESCRIPTION CONTROLLER ASSY TYPE III MODEL A1161

NEXT ASSY END ITEM BY [illegible] CK'D 10-11-82 APPD

REV	ECN	DATE	BY	APP

DELTA DESIGN
5725 KEARNY VILLA RD.
SAN DIEGO, CALIF

JOB NO. S.O. NO
QTY PROM DATE ACT
RUN * MACH

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO	REV	DESCRIPTION	MFG OR MFG NO.	STOCK OR PART NO.
22	1	1	1						DIAL	AMPHENOL 1323	1500784
23	1	1	1				1600464		PANEL, CONTROL		1600464-001
24	1	1	1						LENS, GREEN		1400090
25	1	1	1						LENS, WHITE		1400091
26	1	1	1						LENS, RED		1400092
27	3	3	3						HOLDER, LAMP	SYLVANIA 30099-0	1400076
28	1	1	1						KNOB		1500279
29	3	3	3						LAMP	SYLVANIA 120 PSB	1400084
30		1							SPACING RING (POT)		1500018
31		1							POT	VOAK D-11	0500018
32	1	1	1			B	1654248		RELAY ASSY, SOLID STATE		1654248-001
33											
34											
35											
36	1	1	1						DIODE	IN4004	1104004
37	1	1	1						RESISTOR		0600006
38											
39									SCREW #4-40 x 3/8		6804403-824
40											
41											
42	A/R	A/R	A/R						SCREW #6-32 x 1/2		6806321-224
43	A/R	A/R	A/R						SCREW #6-32 x 3/8		6806323-824
44											
45	A/R	A/R	A/R						NUT #6-32		6706320-000
46											
47											
48											
49	1								POT		0500034
50				1					POT		0500015

JOB QTY	AUL	QTY REC	FAB CD	PURCHASING P.O. NO.	QTY	DUE	REC	MANUFACTURE ACT STD. HRS.	EST ACT COM.	COM	PLATE/PAINT IN	OUT	AREA

NOTES:

1654798
P/L

31

1182

PL 1654799 REV N/C SHT 1 OF 2

DESCRIPTION CONTROLLER ASSY TYPE III MODEL A1172

NEXT ASSY END ITEM BY [illegible] CK'D ____ APPD ____

REV	ECN	DATE	BY	APP
—	[illegible]	[illegible]	[illegible]	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—

DELTA DESIGN
5725 KEARNY VILLA RD
SAN DIEGO, CALIF

JOB NO ____ S O NO ____
QTY ____ PROM DATE ____ ACT ____
RUN # ____ MACH ____

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO	REV	DESCRIPTION	MFG OR MFG NO	STOCK OR PART NO	JOB QTY	AUL	QTY REC	FAB CD	PURCHASING P.O. NO	QTY DUE	REC	MANUFACTURE ACT STD HRS	EST ACT COM	COM	PLATE/PAINT IN	OUT	AREA
00	X					P/L	1654777		CONTROLLER TYPE III MODEL A1172-2 (208/240V -100°TO+600°F)		1654799-001													
00		X				P/L	1654778		CONTROLLER TYPE III MODEL A1172-4 (208/240V -73°TO+315°C)		1654799-002													
00			X			P/L	1654799		CONTROLLER TYPE III MODEL A1172-12 (208/240 -184°TO+315°C)		1654799-003													
00																								
00																								
00	REF	REF	REF			D	1643351		SCHEMATIC CONTROLLER TYPE III															
00	REF	REF	REF			D	1635619		SCHEMATIC CONTROL BD															
00																								
00	REF	REF	REF			C	2638511		x 1 OPTION ASSY															
01	1	1	1			C	2637594		CONTROL BD ASSY		2637594													
02	1	1	1						TERMINAL, BLOCK 2 PIN	CINCH JONES 2-140	1400508													
03	1	1	1						RESISTOR 3.3K OHM 1/2W 5%		0303320-500													
04	1	1	1						TERMINAL, STRIP	SMITH 1088	1400505													
05	1	1	1						TRANFORMER	SPARTON 1201A-8	1400299													
06	18	18	18						NUT, SWAGE		1700028													
07	2	2	2						GROMMET		1500026													
08	4	4	4						STANDOFF		4100092													
09	2	2	2						WASHER, #6 FLAT		6606000													
10	A/R	A/R	A/R						WIRE, AWG #20		1500389													
11	A/R	A/R	A/R						TIE CORD		1501379													
12	6	6	6						LUG		1500065													
13	6	6	6						LUG		1500055													
14	A/R	A/R	A/R						WIRE AWG #18		1500383													
15	1	1	1				1600236		CHASSIS		1600236-001													
16	1	1	1				1600261		BRACKET		1600261-001													
17	8	8	8						RIVET		1700051													
18	2	2	2						TERMINAL BLOCK 8 PIN	KULKA K619	1400520													
19	2	2	2						SWITCH		1400181													
20	1	1	1						SWITCH-MODE	IRC T207	1400189													
21	1	1	1						SWITCH		1400157													
22	1	1	1						DIAL	AMPHENOL 1323	1500784													
23	1	1	1						LENS, GREEN		1400090													
24	1	1	1						LENS, WHITE		1400091													

NOTES: 1 THIS CONTROLLER IS MORE # 208/240V.
2 REF - FOR THERMOCOUPLE B1650230 SEE DRAWINGS AND P/Ls D1650238 & D1650223.

1654799
P/L

32

PL 1654779 REV M/1 SHT 2 OF 2

DESCRIPTION CONTROLLER ASSY TYPE III MODEL AM72

NEXT ASSY END ITEM BY [illegible] CK'D ____ APPD ____

10 11 62

REV	ECN	DATE	BY	APP

DELTA DESIGN
5725 KEARNY VILLA RD
SAN DIEGO, CALIF

JOB NO ____ S O NO ____
QTY ____ FROM DATE ____ ACT ____
RUN * ____ MACH ____

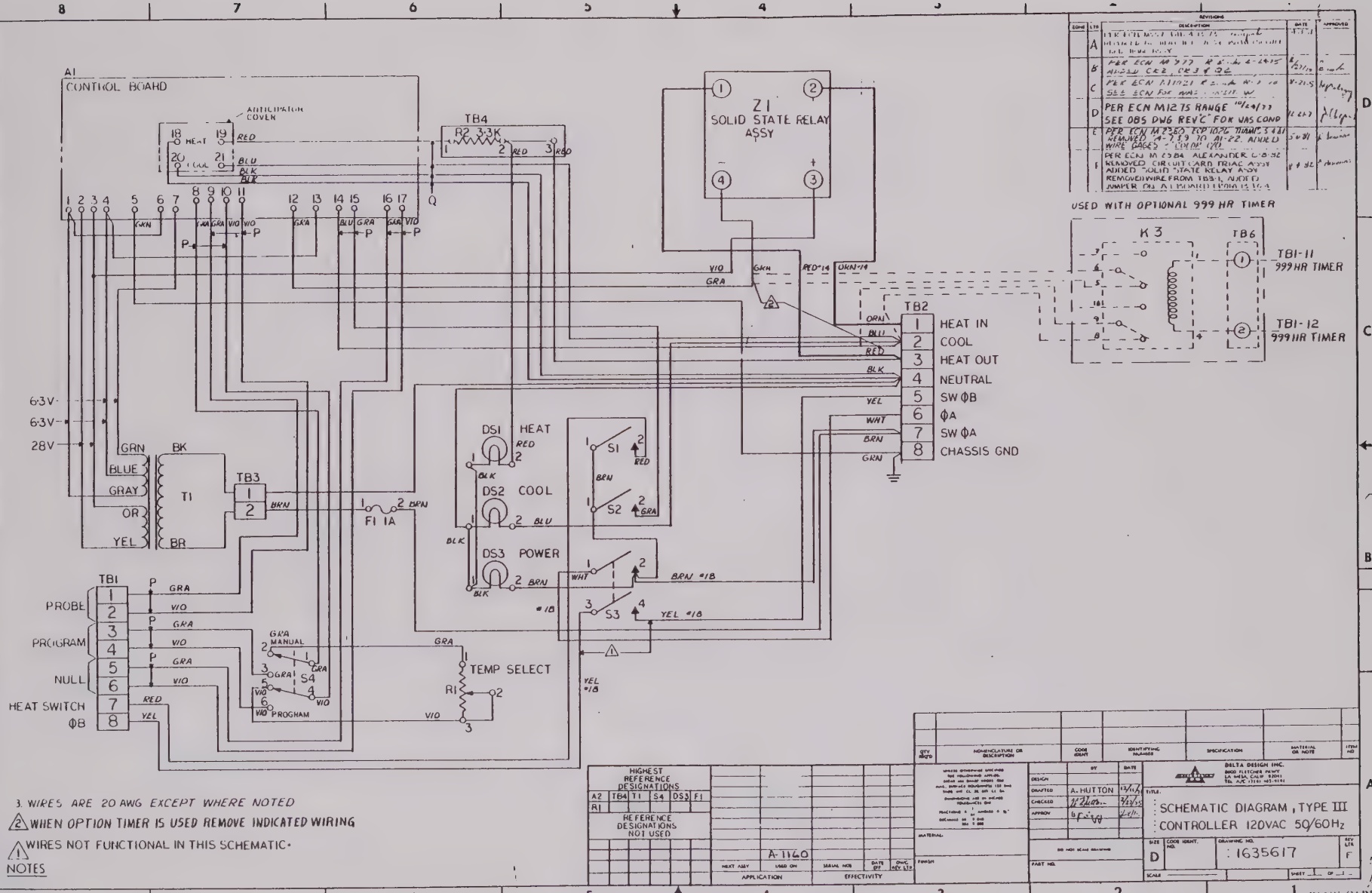
ITEM NO	ASSY QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO	STOCK OR PART NO.	JOB QTY	AUL	QTY REC	FAB CD	PURCHASING P.O. NO	QTY DUE	REC	MANUFACTURE ACT STD HRS	EST ACT COM	ACT COM	PLATE/PAINT IN	OUT	AREA
25	1								LENS, RED		1400092													
26	1	1	1						HOLDER, LAMP	SYLVANIA 30077-0	1400076													
27	1	1	1						KNOB		1500279													
28	3	3	3						LAMP	SYLVANIA 120 PSB	1400084													
29	1	1	1						RESISTOR		2600006													
30		1							POT	VOAK D-11	0500018													
31	1	1	1						DIODE	IN4004	1104004													
32			1				1630462		PANEL, CONTROL (C°)		1630462-001													
33	1	1					1630462		PANEL CONTROL (F°)		1630462-002													
34									SCREW #4-40 x 3/8		6804403-824													
35																								
36																								
37	A/R	A/R	A/R						SCREW #6-32 x 1/2		6806321-224													
38	A/R	A/R	A/R						SCREW #6-32 x 3/8		6806323-824													
39																								
40	A/R	A/R	A/R						NUT #6-32		6706320-000													
41																								
42																								
43	1								POT		0500034													
44			1						POT		0500015													

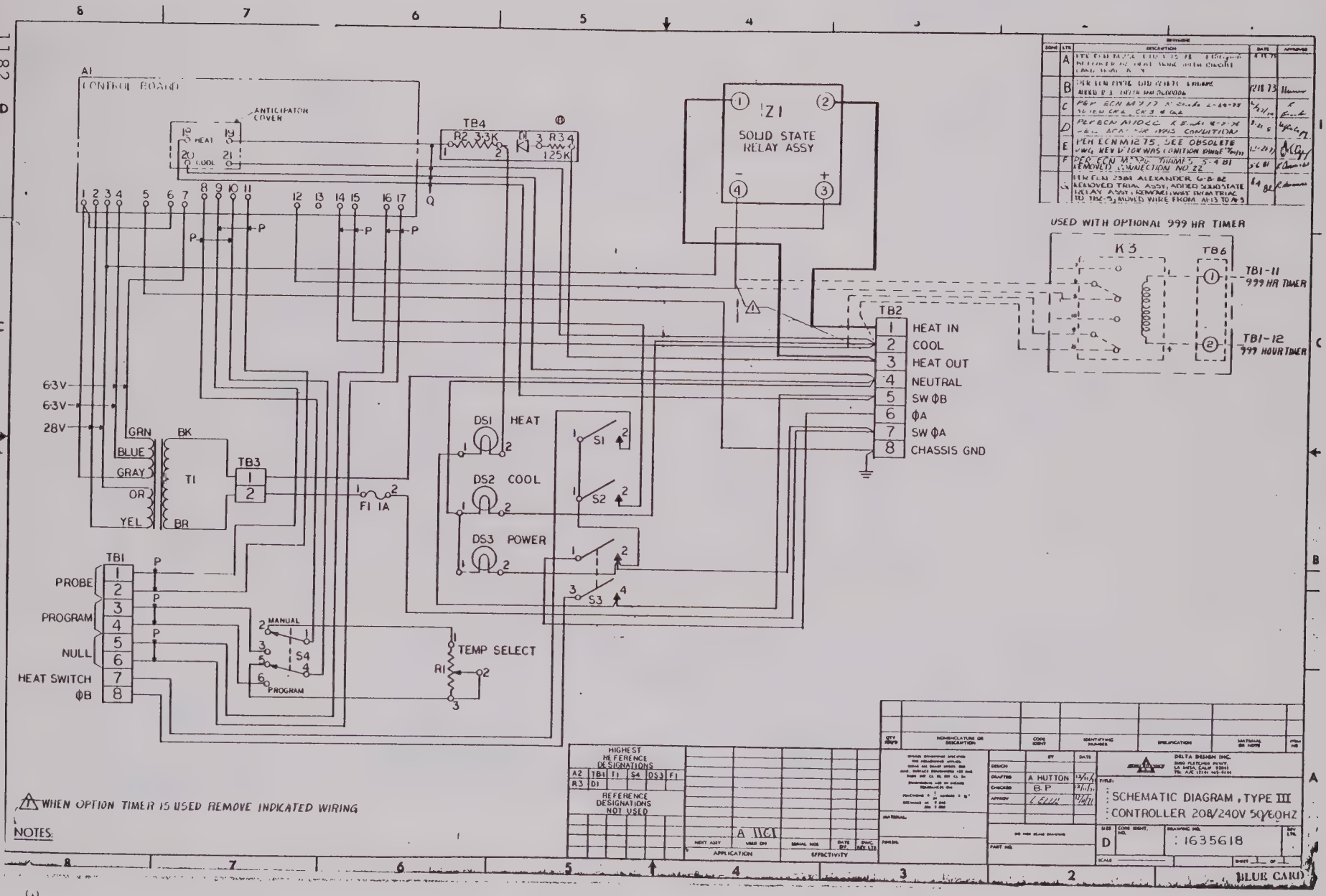
NOTES:

1654779
P/L

CONTROLLER OPTION
PARTS LIST

Controller Model	Temperature Range	Scale	Potentiometer	Delta P/N	R29 Value	Delta P/N
A1160-1	-100 to +600	°F	D-12	0500034	118	0400020
A1160-3	-73 to +315	°C	D-11	0500018	118	0400020
A1160-5	-300 to +600	°F	D-16	0500013	26	0400018
A1160-11	-184 to +315	°C	D-24	0500015	26	0400018
A1160-17	-100 to +350	°F	D-48	0500011	118	0400020
A1160-19	-73 to +177	°C	D-42	0500033	118	0400020

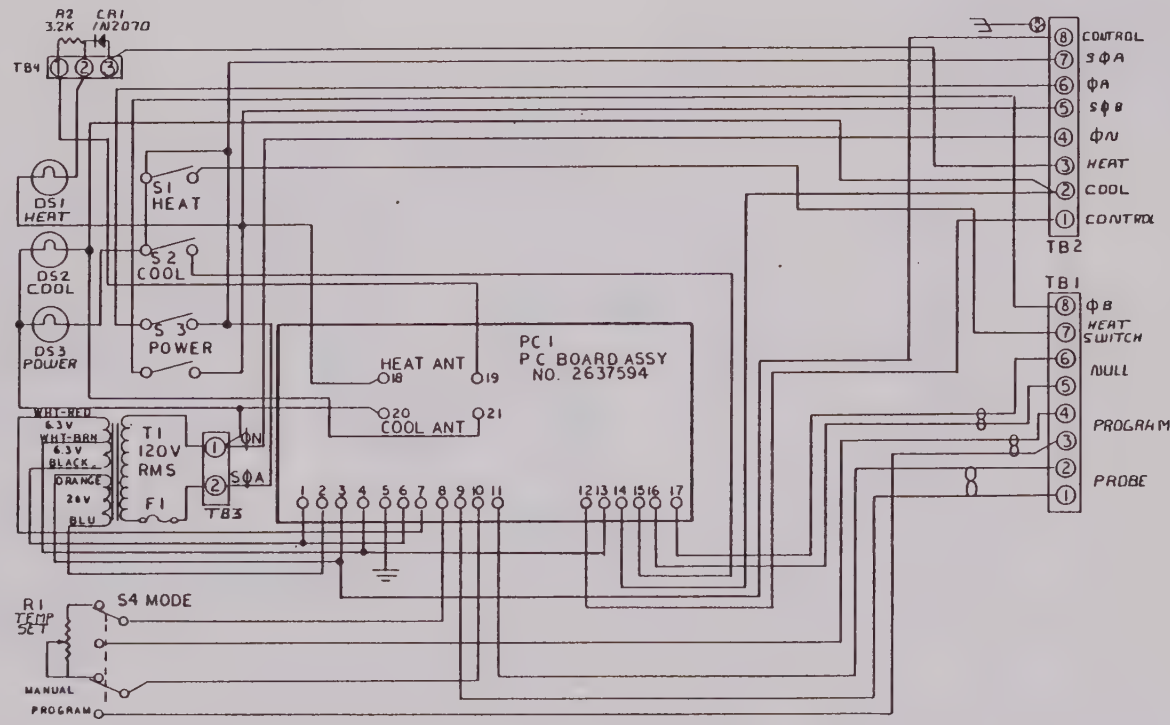

A1
CONTROL BOARD
ANTICIPATOR COVER
HEAT
COOL
RED
BLU
BLK
TB4
R2 3.3K
Z1
SOLID STATE RELAY ASSY
USED WITH OPTIONAL 999 HR TIMER
K3
TB6
TB1-11
999 HR TIMER
TB1-12
999 HR TIMER
TB2
1 HEAT IN
2 COOL
3 HEAT OUT
4 NEUTRAL
5 SW ΦB
6 ΦA
7 SW ΦA
8 CHASSIS GND
6.3V
6.3V
28V
T1
TB3
F1 1A
DS1 HEAT
DS2 COOL
DS3 POWER
S1
S2
S3
S4
TB1
PROBE
PROGRAM
NULL
HEAT SWITCH ΦB
MANUAL
PROGRAM
TEMP SELECT
R1
REVISIONS
PER ECN M1275 RANGE "10/29/73
SEE OBS DWG REV'C' FOR WAS COND
PER ECN M2350 EXP 1026 THANG 3 481
REMOVED 14-739 TO A1-22 ADDED
WIRE PAGES - LOUIE 1/81
PER ECN M 2584 ALEXANDER 6-8-82
REMOVED CIRCUIT CARD TRIAC ASSY
ADDED "SOLID STATE RELAY ASSY
REMOVED WIRE FROM TB3-1, ADDED
JUMPER ON A1 BOARD FROM TB3-1
3. WIRES ARE 20 AWG EXCEPT WHERE NOTED
2 WHEN OPTION TIMER IS USED REMOVE INDICATED WIRING
1 WIRES NOT FUNCTIONAL IN THIS SCHEMATIC.
NOTES
HIGHEST REFERENCE DESIGNATIONS
REFERENCE DESIGNATIONS NOT USED
DELTA DESIGN INC.
SCHEMATIC DIAGRAM, TYPE III
CONTROLLER 120VAC 50/60Hz
1635617
A-1160



1182 D

SS RELAY CONFIGURATION

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPD
	A	PER ECN M2383 THAMES 5-4-81 REMOVED CONNECTION NO 22	5-6-81	R. Williams
	B	PER ECN M 2384 ALEXANDER 6-11-81 MOVED WIRE FROM PL1-13 TO PL1-3	8-4-81	R. Williams



		REF		A 1172				
DASH QTY	NEXT ASSY	USED ON	SERIAL NO.	DATE EFF	DWG REV	MATERIAL ⚠		
APPLICATION			EFFECTIVITY			FINISH ⚠		

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS .XX ± .05, .XXX ± .010
ANGLES ±30'
HOLE TOLERANCES

ENGINEERING ACTIVITY	
	ECN M 1024
DESIGN	
DRAFTED	RWILLIAMS 5-23-73
CHECKED	
APPROV	[illegible] 8-21-5
RELEASE	
DO NOT SCALE DWG	

DELTA DESIGN INC.
A SUBSIDIARY OF CONN INC.
8738 REARNY VILLA RD SAN DIEGO, CA. 92138 - TEL (714) 292-6000

TITLE: SCHEMATIC DIAGRAM, A1172 CONTROLLER

SIZE C | CODE IDENT | 1643351 | REV B

SCALE —

SHEET 1 OF 1

⚠ FINISH (to applicable)

⚠ MATL (to applicable)

NOTES: UNLESS OTHERWISE SPECIFIED

BISHOP GRAPHICS/ACCUPRESS NUMBER NO. 3130

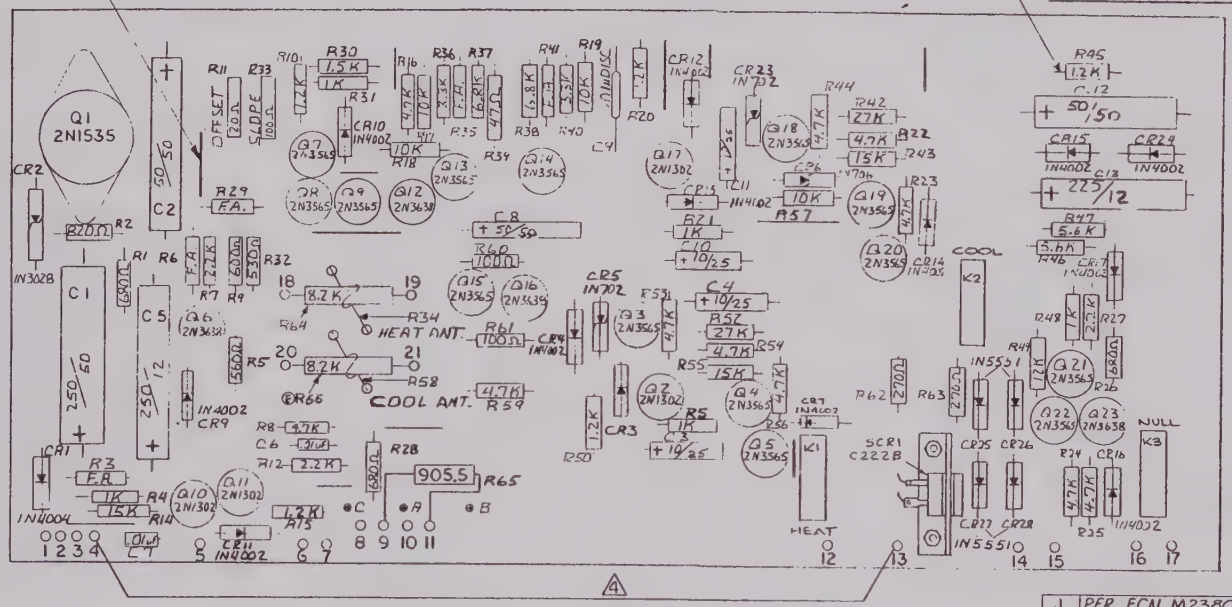
BLUE CARD

1182

REVISIONS			
ZONE LTR	DESCRIPTION	DATE	APPD
A	PER ECN M-232 DATED 3-2-73 BY MORSE. ADDED NOTE 3 : R3, R35 AND R41 TO BE 1/4 W.	3-2-73 MORSE	
B	PER ECN M308. DATED 6-22-73 BY WILLIAMS ADD TO NOTE 3: R29 232 TO BE 1/4 W	6-22-73	Harris
C	PER ECN M788. AHMED 8-2-74	8-02-74	R Bourke
D	PER ECN M910 AHMED 10-10-74	10/10/74	R Bourke
E	PER ECN M923 AHMED 10-24-74	10/24/74	R Bourke
F	PER ECN M977 R Bourke 2-24-75 SEE ECN FOR WAS CONDITION	2/27/75	R Bourke
G	PER ECN M1023 R Bourke 8-7-75 SEE ECN FOR WAS CONDITION	8-12-75	R Bourke
H	PER ECN 1218 G Jackson 6/15/77 ENG'D K1, K2, K3 TO PRESENT CONFIG.	6/15/77	M Cloyd

BUS WIRE JUMPER (12 PLCS)

ATTACH SCOPE HERE TO MONITOR NULL. CONNECT SCOPE GND TO CHASSIS GND.



J	PER ECN M2380 THAMES 5-4-81 REMOVED CONNECTION POINT NO. 22"	5-6-81	R Ariwan
K	PER ECN M2984 ALEXANDER 6-8-82 ADDED NOTE 4	8-4-82	R. Ariwan

4 ADD JUMPER BETWEEN 4 & 13 AT ASSY USING 24 AWG WIRE

3 RESISTORS DESIGNATED BY "F.A" ARE FACTORY ADJUST RESISTORS.

2 FINISH (to specification)

1 MATL (to specification)

NOTES: UNLESS OTHERWISE SPECIFIED

DASH	QTY	NEXT ASSY	USED ON
			1140
			1122
			1778
			1172
			1161
			1160

APPLICATION

SERIAL NO. | DATE EFF | DWG REV

EFFECTIVITY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES, ON DECIMALS .XX ± .03 .XXX ± .010 ANGLES 0°30'

HOLE TOLERANCES

.013 THRU .133 +.004 −.001 .251 THRU .500 +.006 −.001

.136 THRU .250 +.005 −.001 .501 THRU .750 +.008 −.001

MATERIAL 1

FINISH 2

ENGINEERING ACTIVITY

DESIGN	J.C
DRAFTED	R. WMS 3-5-73
CHECKED	M Hutton
APPROV	Harris 4-17-73
RELEASE	R Bourke 2/27/75

DO NOT SCALE DWG

DELTA DESIGN INC.
A SUBSIDIARY OF CONTROL DATA INC.
5725 KEARNY VILLA RD SAN DIEGO, CA. 92123 - TEL (714) 292-3000

TITLE: PC ASSEMBLY TYPE III CONTROLLER

SIZE	CODE IDENT	
C		2637594 K

SCALE NONE SHEET 1 OF 1

38

BLUE CARD

1182

P.L. 1648696 REV ____ SHT 5 OF 8

DESCRIPTION DIGITEMP CONTROLLER 208/240V

NEXT ASSY END ITEM BY ____ CK'D ____ APPD ____

REV	ECN	DATE	BY	APP

DELTA DESIGN
5725 KEARNY VILLA RD
SAN DIEGO, CALIF

JOB NO. ____ S.O. NO. ____
QTY ____ PROM DATE ____ ACT ____
RUN * ____ MACH ____

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO.	STOCK OR PART NO.
44	1	1				C	2637594		PC BOARD ASSY TYPE III CONTROLLER		2637594-001
01	1	1				D	1605624		PC BRD DRILL, CONTROLLER TYPE III		1605624-101
02	1	1							CAPACITOR C2, C8, C12	50uf/50V	0704700-050
03	2	2							CAPACITOR C5, C13,	220uf/12V	0722000-012
04	4	4							CAPACITOR C3, C4, C10,	C11, 10uf/25V	0701000-025
05											
06	3	3							CAPACITOR C6, C7, C9,	.01uf/600V	0700120-600
07	1	1							CAPACITOR C1, 250uf/50V		0725000-050
08	3	3							RESISTOR R14, R43, R	55, 15K 5% 1/2W	0301530-500
09	2	2							RESISTOR R36, R40 3.	3K 5% 1/2W	0303320-500
10	2	2							RESISTOR R59, R64 8.	2K 5% 3W	0600005
11	1	1							RESISTOR R49, 12K 5	% 1/2W	0301230-500
12	3	3							RESISTOR R1, R26, R28	,680Ω 5% 1/2W	0368000-500
13	1	1							RESISTOR R5, 560Ω	5% 1/2W	0356000-500
14	2	2							RESISTOR R62, R63, 2	70Ω 5% 1/2W	0327000-500
15	2	2							RESISTOR R60, R61, 1	00Ω 5% 1/2W	0310000-500
16	1	1							RESISTOR R39, 47Ω 5	% 1/2W	0304700-500
17	2	2							RESISTOR R46, R47 5	.6K 5% 1/2W	0305620-500
18	1	1							RESISTOR R30, 1.5K	5% 1/2W	0301520-500
19	1	1							RESISTOR R9 600Ω 1%	WIREWOUND 1/4W	0400022
20	4	4							DIODE CR 25 THRU C	R28 IN5551	1105551
21	1	1							RESISTOR R32 530Ω 1%	WIREWOUND 1/4W	0400021
22	5	5							RESISTOR R4, 5, 21, 31,	48 1K 5% 1/2W	0300130-500
23	5	5							RESISTOR R10, 15, 20, 45	, 50 1.2K 5% 1/2W	0301220-500
24	3	3							RESISTOR R7, R12, R27	2.2K 5% 1/2W	0302220-500
25	11	11							RESISTOR R8, 16, 22-25	, 44, 53, 54, 55,	
									56, 59 4.7K 5%	1/2W	0304720-500
26	2	2							RESISTOR R37, R38	6.8K 5% 1/2W	030 6820-500
27	4	4							RESISTOR R17-19, R57	10K 5% 1/2W	0301030-500
28	2	2							RESISTOR R42, R52 27	K 5% 1/2W	0302730-500
29	1	1							DIODE CR1, N4004		1104004
30	13	13							DIODE CR3, 4, 7, 9-17	, 24 IN4002	1104002
31	1	1							DIODE CR2	IN3028	1100022

JOB QTY	ALL	QTY REC	FAB CD	PURCHASING P.O. NO	QTY DUE	REC'D	MANUFACTURE ACT STD HRS	EST ACT COM	COM	PLATE/PAINT IN	OUT	AREA

NOTES:

P/L 1648696

39

1182

PL 1648696 REV ____ SHT 6 OF 8

DESCRIPTION DIGITEMP CONTROLLER 208/240V

NEXT ASSY END ITEM BY PAT CK'D ____ APPD ____

REV	ECN	DATE	BY	APP

DELTA DESIGN
5725 KEARNY VILLA RD.
SAN DIEGO, CALIF.

JOB NO. ____ S.O. NO. ____
QTY ____ PROM DATE ____ ACT ____
RUN ____ MACH ____

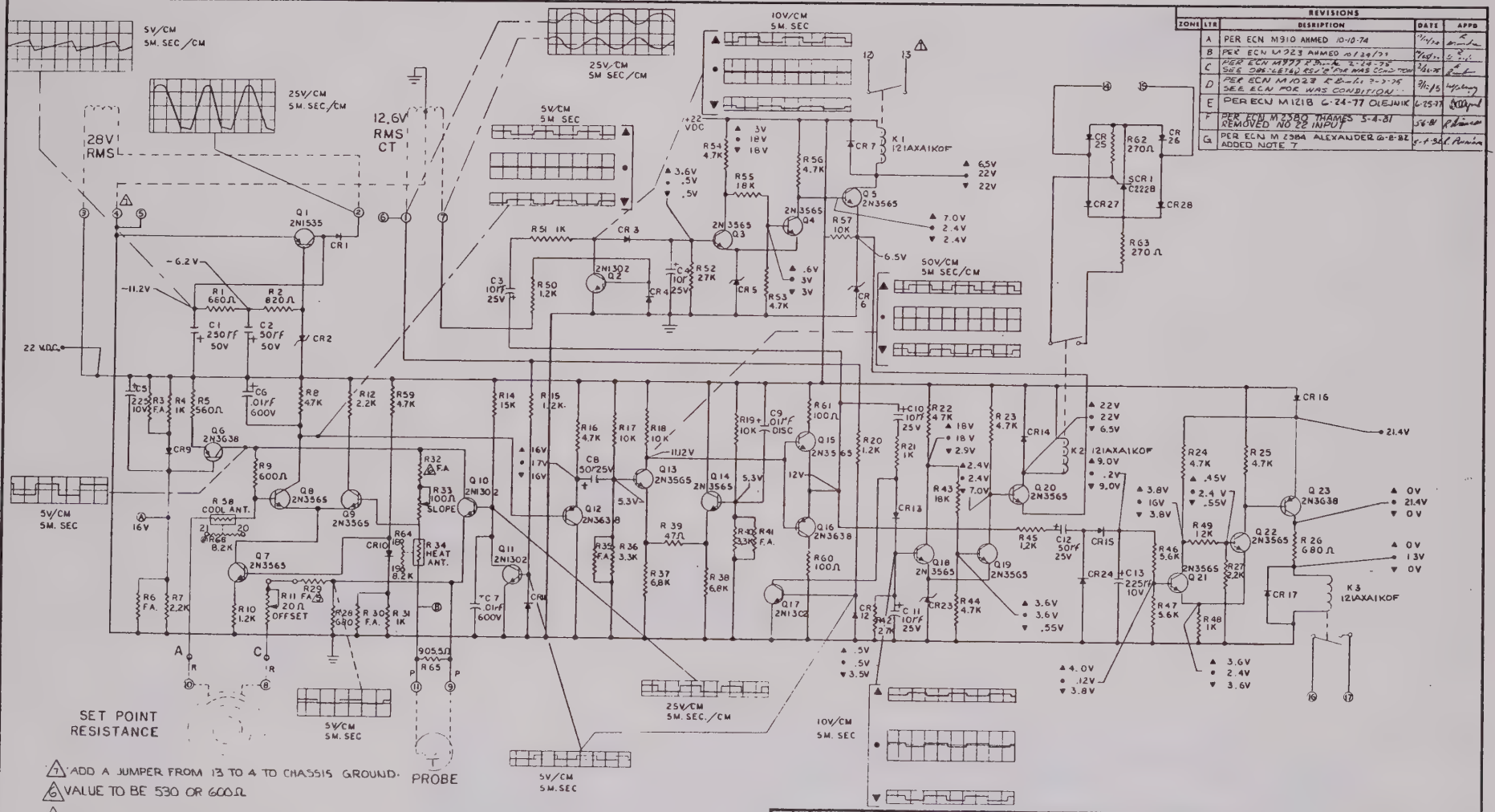
ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO.	STOCK OR PART NO.
32	1	1							DIODE CR6	IN706	1100706
33	2	2							DIODE CR5, CR23	IN702	1100702
34	4	4							TRANSISTOR Q6,12,16,23	2N3638	1203638
35	14	14							TRANSISTOR Q3-5,7-9,13-15,18-22	2N3565	1203565
36	4	4							TRANSISTOR Q2,10,11,17	2N1302	1201302
37	1	1							TRANSISTOR Q1	2N1535	1201535
38	8	8							TRANSISTOR PAD		1500301
39	1	1							RESISTOR 820 OHM	5% 1/2W	0382000-500
40	1								~~SWITCH (SCR)~~		~~1400552~~
41	3	3							RELAY K1-K3	E.A.C. 121AXA1KOF	1400216
42	21	21							TERMINAL POST		1400550
43	1	1							SLEEVING		1500105
44	2	2							6-32 x 3/8 PHP-MS-	SST	6806323-804
45	2	2							4-40 x 3/4 PHP-MS-	SST	6804403-404
46	2	2							4-40 x 3/8 PHP-MS-	SST	6804403-804
47	2	2							6-32 HN-SST		6706320
48	2	2							#6 FW-SST		6606010
49	6	6							4-40 HN-SST		6704400
50	2	2							#4 WASHER		6704010
51	1	1							POTENTIOMETER 20Ω 20TURN	WIREWOUND	0500038
52	1	1							POTENTIOMETER 100Ω 20TURN	WIREWOUND	0500037
53	1	1				A	1600260		COVER, ANTICIPATOR		1600260
54	1								~~BRACKET~~		~~1600466~~
55	4	4							#6 FW-FIBER		6606008
56	4	4							TERMINAL POST		1400500
57	1	1							RESISTOR R65 905.5Ω .05%		0400008
58	REF	REF							F.A. RESISTOR R29		0400018,19 OR 20
59	REF	REF							F.A. RESISTORS R3,R6,R35 & R41 CARBON 1/4 W 5%		
60	1	1				B	1643414		BRACKET-SCR SWITCH ASSY		1643414-101

JOB QTY	ALL	QTY REC	FAB CD	PURCHASING P.O. NO.	QTY	DUE	REC	MANUFACTURE STD HRS	ACT EST COM	ACT COM	PLATE/PAINT IN	OUT	AREA

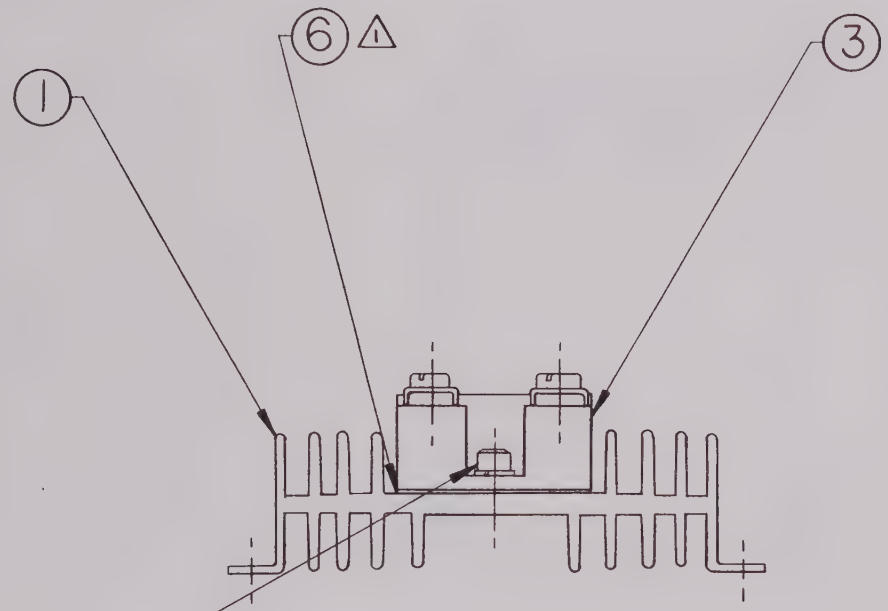
NOTES:

1648696
P/L

40


REVISIONS
ZONE LTR DESCRIPTION DATE APPD
A PER ECN M310 AHMED 10-10-74
B PER ECN M323 AHMED 10-24-74
C PER ECN M377 R.Brink 2-18-75 SEE DRAWING REV 'B' FOR WAS CONDITION
D PER ECN M1023 R.Brink 3-3-75 SEE ECN FOR WAS CONDITION
E PER ECN M1218 6-24-77 OLEJNIK
F PER ECN M2380 THAMES 5-4-81 REMOVED NO 22 INPUT
G PER ECN M 2384 ALEXANDER 6-8-82 ADDED NOTE 7
28V RMS
12.6V RMS CT
22 VDC
+22 VDC
SET POINT RESISTANCE
PROBE
K1 121AXA1KOF
K2 121AXA1KOF
K3 121AXA1KOF
SCR1 C222B
7 ADD A JUMPER FROM 13 TO 4 TO CHASSIS GROUND.
6 VALUE TO BE 530 OR 600Ω
5 VALUE TO BE 118, 107 OR 26Ω
4. ALL VOLTAGES ARE D.C. MEASURED FROM CHASSIS GROUND
3. ▲ SET POINT CONTROL, 10°F HIGHER THAN NULL
2. ● SET POINT CONTROL, SET AT NULL
1. ▼ SET POINT CONTROL, 10°F LOWER THAN NULL
NOTES: UNLESS OTHERWISE SPECIFIED
ENGINEERING ACTIVITY
DESIGN
DRAFTED R WMS 3-5-75
CHECKED 3/7/75
APPROV 3/5/75
RELEASE 3-10-75
DO NOT SCALE DWG
DELTA DESIGN INC.
TITLE: SCHEMATIC DIAGRAM, CONTROL BD-TYPE III CONTROLLER
SIZE D
CODE IDENT
1635619
REV G
SCALE NONE
SHEET 1 OF 1
REF D2637594
MATERIAL
FINISH

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPD



MULTIUSAGE

△1 THOUGHLY COAT BOTTOM OF RELAY WITH THERMAL COMPOUND TO CREATE A GOOD HEAT CONDUCTIVITY WITH HEAT SINK

NOTES: UNLESS OTHERWISE SPECIFIED

DASH	QTY	NEXT ASSY	USED ON
		MULTIUSAGE	
001	1	1648289	
001	1	1641192	
001	1	1650477	
001	1	1650160	

APPLICATION | SERIAL NO. | DATE EFF | DWG REV | EFFECTIVITY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .XX ± .03, .XXX ± .010
ANGLES: 0° 30'

MOLE TOLERANCES

.012 THRU .125	+.004 −.001	.251 THRU .500	+.006 −.001
.126 THRU .250	+.005 −.001	.501 THRU .750	+.008 −.001

MATERIAL
FINISH
DO NOT SCALE DWG

ENGINEERING ACTIVITY: ECN M 2984

DESIGN	
DRAFTED	ALEXANDER 9/21/82
CHECKED	
APPROV	
RELEASE	

DELTA DESIGN INC.
A SUBSIDIARY OF CONU INC.
SAN DIEGO, CA. 92123

TITLE: RELAY ASSY, SOLID STATE

SIZE	CODE IDENT		REV.
B		1654248	N/C

SCALE FULL | SHEET 1 OF 1

P.L. 1654248 REV N/C SHT 1 OF 1

DESCRIPTION RELAY ASSY, SOLID STATE

NEXT ASSY MULTIUSAGE BY RA CK'D ____ APPD ____

REV	ECN	DATE	BY	APP
N/C	2084	9-27		

DELTA DESIGN
5725 KEARNY VILLA RD.
SAN DIEGO, CALIF.

JOB NO. ____ S.O. NO. ____
QTY ____ PROM DATE ____ ACT ____
RUN * ____ MACH ____

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO.	STOCK OR PART NO.
00	X					B	1654248		RELAY ASSY SOLID STATE		1654248-001
01	1					B	1654184		HEATSINK, SOLID STATE RELAY		1654184-101
02											
03	1								RELAY, SOLID STATE		1400194
04	2								SCREW 8-32 X .375 SHC-MS		6808323-808
05	2								WASHER, SPLIT #8		6608010
06	1/R								THERMAL COMPOUND		9900026

JOB QTY	AUL	QTY REC	FAB CD	PURCHASING P.O. NO.	QTY DUE	REC	MANUFACTURE ACT STD HRS	EST ACT COM	COM	PLATE/PAINT IN	OUT	AREA

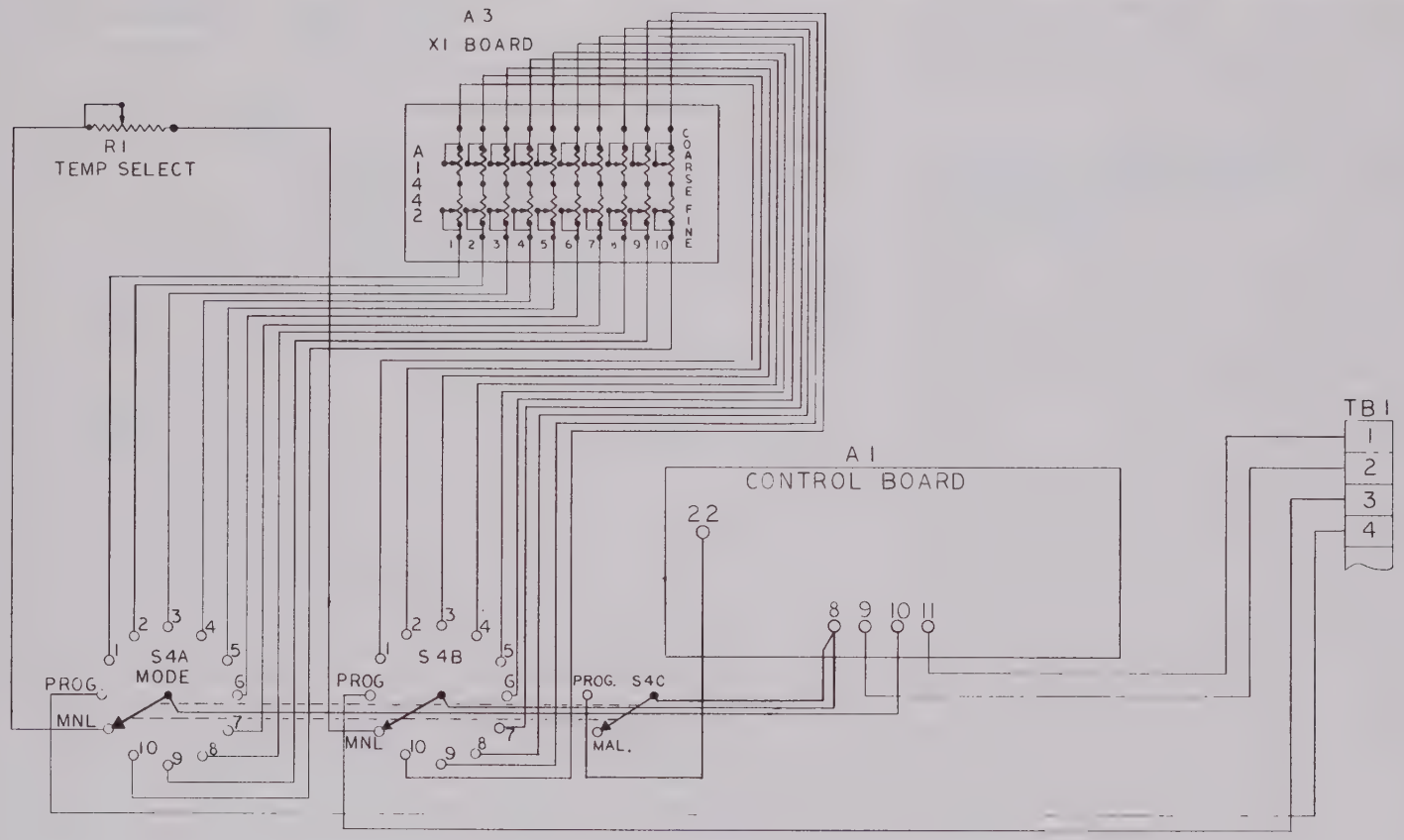
NOTES:

1654248
P/L

REV

1182

REVISIONS				
ZONE	LTR	DESRIPTION	DATE	APPD
	A	PER ECN M1020 RB 8-7-75 ADDED S4C & A1-22	8-21-5	



| | | | |

FORM 4-17-72

DELTA DESIGN, INC.
5725 KEARNY VILLA RD
SAN DIEGO, CA. 92123
TEL. (714) 292-5000

NOTES:

ITEM	QTY	DRAWING NUMBER	DESCRIPTION	MANUFACT AND NO.	STK OR PART NO.	FAB CODE
00	REF		X1 OPTION ASSY			
01	1	△1	PC BOARD A3		1639955	
02	A/R		POTENTIOMETER 10 OHM FINE	BOURNS 3367-P-1-100	0500027	
03	A/R		POTENTIOMETER 500 OHM COURSE	BOURNS 200L-1-200M	0500028	
04	1		SWITCH, MODE S4	CTS T225	1400190	
05	3		STANDOFF, SCREW		4100192	
06	A/R		TERMINAL, SOLDER		1400550	
		△	ART - 1639955 DRILL - 1633534			

REVISIONS

REV	DATE	BY	APPD	DESCRIPTION
A	8-7-75	RB	byc	ITEM 4 WAS CTS215 (ECN #1020)
B	3-8-78	D Emmett	[illegible]	ITEM 1 WAS 1300009

TITLE: X1 OPTION ASSEMBLY

NEXT ASSY P/L:

BY	ROGER WILLIAMS	8-10-73
CHK	[illegible]	8.13.73
APPD	[illegible]	8-13-73

P/L 2638511 REV B SHT 1 OF 1

1182

45

CCOPRESS BINDER

BFS 2507 EMB

MADE BY

CCO PRODUCTS, INC.

NG ISLAND CITY, N.Y., U.S.A.

www.manualsplus.com
1018284